(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 287 986 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:
05.03.2003 Bulletin 2003/10

(21) Application number: **02722786.7**

(22) Date of filing: **25.04.2002**

(51) Int Cl.[7]: **B41F 7/02**, B41C 1/10, G03F 7/00, G03F 7/004

(86) International application number:
PCT/JP02/04144

(87) International publication number:
WO 02/087882 (07.11.2002 Gazette 2002/45)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **26.04.2001 JP 2001129968**
11.05.2001 JP 2001141342
06.06.2001 JP 2001170705
21.06.2001 JP 2001187564

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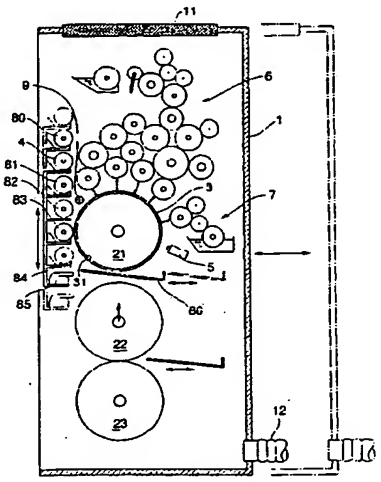
(54) METHOD AND DEVICE FOR REGENERATIVE PROCESSING AND PRINTING

(57) The regenerative plate making and printing process. and plate making and printing apparatus of the present invention are applied to a printing system requiring a separate developing step independent of a printing step. In accordance with the present invention, by repeatedly conducting (A) a photosensitive layer-coating step of coating a photosensitive plate material onto a substrate to prepare a photosensitive lithographic plate having a photosensitive layer thereon; (B) an exposure step of exposing the photosensitive layer to image light; (C) a development step of supplying a plate-treating agent to the photosensitive layer to form developed images thereon; (D) a printing step of supplying a printing ink and dampening water to surfaces of the thus obtained images to conduct printing; and (E) a substrate regeneration step of removing the image portions from the substrate to regenerate the substrate, on the same rotary drum or conveyer, it is possible to considerably improve the working efficiency and stably provide high-quality images.

FIG.1



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Printed by Jouve, 75001 PARIS (FR)

[0010] That is, in a first aspect of the present invention, there is provided a regenerative plate making and printing process comprising:

(A) a photosensitive layer-coating step of coating a photosensitive plate material fed from a photosensitive plate material-feeding mechanism onto a substrate to prepare a photosensitive lithographic plate having a photosensitive layer thereon;
(B) an exposure step of exposing the photosensitive layer of the photosensitive lithographic plate to image light by an exposure mechanism;
(C) a development step of supplying a plate-treating agent to the image-exposed photosensitive layer from a plate-treating agent-feeding mechanism to form images thereon;
(D) a printing step of supplying a printing ink and dampening water to surfaces of the images obtained in the step (C) from an inking device and a dampening device, respectively, to conduct printing; and
(E) a substrate regeneration step of removing the image portions from the substrate by a plate material-removing mechanism to regenerate the substrate,
the development step (C) being conducted independent of the printing step (D), and the steps (A) to (E) being repeated on the same rotary drum or conveyer.

[0011] In a second aspect of the present invention, there is provided a regenerative on-printing machine plate making and printing apparatus comprising:

a lithographic printing machine including a plate cylinder, a bracket cylinder, an impression cylinder, an inking device and a dampening device;
a substrate-fixing means for fixing a substrate on the plate cylinder;
a plate material-feeding mechanism for supplying a photosensitive plate material onto the substrate;
an exposure mechanism for exposing a photosensitive lithographic plate thus formed by supplying and coating the photosensitive plate material onto the substrate, to image light;
a plate material-removing mechanism comprising a plate material-dissolving solution-feeding mechanism, and optionally a plate material-stripping roller, a wash water-feeding mechanism, an waste solution suction mechanism and an air-drying mechanism;
a casing having a slidable and openable front for accommodating all of the components therein; and
a dust filter disposed on a ceiling portion of the casing.
the plate cylinder, the bracket cylinder and the impression cylinder being adjustably disposed to be spaced apart from each other, delivery of papers to the impression cylinder being controllably stopped, and the inking device and the dampening device being adjustably disposed to be spaced apart from the plate cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a conceptual view showing an embodiment of an apparatus for carrying out the regenerative on-printing machine plate making and printing process of the present invention; and
Fig. 2 is a conceptual view showing an embodiment of an apparatus for carrying out the regenerative plate making process of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] The preferred embodiments of the present invention are described in detail below by referring to the accompanying drawings. In the figures, reference numeral (1) denotes a casing; (11) is a dust filter; (12) is an exhaust duct; (21) is a plate cylinder; (22) is a bracket cylinder; (23) is an impression cylinder; (3) is a substrate (lithographic plate); (31) is a substrate-fixing means: (4) is a plate material-feeding mechanism; (5) is an exposure mechanism; (6) is an inking device: (7) is a dampening device; (9) is a light-heating type drying mechanism; (80) is a plate-treating agent-feeding mechanism: (81) is a plate material-dissolving solution-feeding mechanism; (82) is a plate material-stripping roller: (83) is a wash water-feeding mechanism; (84) is an waste solution suction mechanism; (85) is an air-drying mechanism: and (86) is an anti-staining tray.

[0014] In the process according to the first aspect of the present invention, the respective exposure, development, printing and regeneration steps are conducted on a rotary drum or conveyer in sequential and independent manners. That is, the present invention is characterized in that the development step is conducted independent of the printing step.

pression cylinder (23). The sliding mechanism of the anti-staining tray (86) may be constituted, for example, by a suitable rack and pinion gear mechanism.

[0023] The sliding motion of the openable front of the casing (1) is readily conducted, for example, by guide rails (not shown) disposed on a floor. As the dust filter disposed on the ceiling portion of the casing (1), there may be used commercially available products. In Fig. 1, reference numeral (12) denotes an exhaust duct provided, if required, at the bottom portion of the casing (1).

[0024] The plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) are movable so as to be spaced apart from each other, for example, by a suitable mechanical means such as eccentric bushings fitted in the bracket cylinder (22) and the impression cylinder (23). Also, an inking roller of the inking device (6) and a dampening roller of the dampening device (7) are movable so as to be spaced apart from the plate cylinder (21) by a suitable mechanical means such as the cam provided on the plate cylinder (21) and links provided on the respective rollers.

[0025] The above described means and mechanisms for modification of lithographic printing machines will be readily constituted by one having an ordinary skill in the art, from known and customary techniques by referring to the teachings of the present invention.

[0026] In the process of the present invention, after keeping the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) apart from each other, and stopping delivery of papers to the impression cylinder, at the step (A), a photosensitive plate material composed of a photosensitive composition is supplied from the plate material-feeding mechanism (4) and coated onto the substrate (3) fixed on the plate cylinder (21) to prepare a photosensitive lithographic plate; then, at the step (B), the thus prepared photosensitive lithographic plate is exposed to image light by the exposure mechanism (5); at the step (C), a plate-treating agent is fed onto the thus image-exposed photosensitive lithographic plate from the plate-treating agent-feeding mechanism, followed by optionally applying physical stimulus thereto, to form images thereon; then, at the step (D), a printing ink and dampening water are supplied onto surfaces of the images formed on the photosensitive lithographic plate, from the inking device (6) and the dampening device (7), respectively, and the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) are rotated while being kept in contact with each other and supplying a printing paper between the bracket cylinder (22) and the impression cylinder (23) to conduct printing; and successively, after keeping the respective cylinders apart from each other and stopping delivery of papers to the impression cylinder (23) again, at the step (E), image portions formed on the substrate (3) are removed by the plate material-removing mechanism, thereby regenerating the substrate (3).

[0027] In the followings, the respective plate making, printing and regeneration steps that are repeatedly conducted using the lithographic printing machine having a printing section including the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) are illustratively described.

<Plate making steps (A) to (C)>

[0028] As the substrate (3), there may be used, for example, grain-treated aluminum plates. The photosensitive plate material composition is not particularly restricted, and any compositions conventionally known as photosensitive plate materials may be used without particular limitations. Among them, the following photopolymerizable compositions proposed by the present inventors are preferred:

(1) Photopolymerizable compositions containing an urethane-based compound as an ethylenic monomer having 4 or more urethane bonds and 4 or more addition-polymerizable double bonds in one molecule, and a photopolymerization initiator;

(2) photopolymerizable compositions for near-infrared laser exposure, containing (a) an ethylenic compound, (b) cyanine-based sensitizing dye cation and/or phthalocyanine-based sensitizing dye having heterocyclic rings bonded to each other through a polymethine chain, and (c) organoboron anion and/or halomethyl-containing compound; and

(3) photopolymerizable compositions for blue violet laser exposure, containing an ethylenically unsaturated compound, and a hexaarylbiimidazole-based compound or a titanocene compound, and a dialkylaminobenzene-based compound as a photopolymerization initiator.

[0029] First, after keeping the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) spaced apart from each other and stopping delivery of papers to the impression cylinder (23), at the step (A), the photosensitive plate material composed of a photosensitive composition is supplied from the plate material-feeding mechanism (4) and applied onto the substrate (3) fixed on the plate cylinder (21) to prepare a photosensitive lithographic plate (photosensitive layer-coating step).

[0030] In the present invention, when the photosensitive layer is formed on the substrate (3) to prepare a photosensitive image-forming material, the obtained photosensitive image-forming material is preferably heat-dried by irradiating

controlled on the basis of the detected data, it is possible to always attain a constant reproducibility of developed images in the development step (C) independent of the change in composition of the developing solution due to absorption of carbon dioxide gas in air.

[0042] The present invention is characterized in that the development step (C) is provided separately from the printing step, and in that the plate-treating agent-feeding mechanism is disposed.

<Printing step (D)>

[0043] After completion of the plate making step, at the step (D), the surfaces of the images formed on the photosensitive lithographic plate are supplied with a printing ink and dampening water from the inking device (6) and the dampening device (7), respectively. Then, the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) are rotated in contact with each other, and at the same time a printing paper is delivered between the bracket cylinder (22) and the impression cylinder (23) to conduct printing thereon. Such procedures may be conducted according to the conventionally known methods.

<Regeneration step (E)>

[0044] After completion of the printing step, the respective cylinders are kept to be spaced apart from each other, and the delivery of papers to the impression cylinder (23) is stopped again. Thereafter, at the step (E), the image portions on the substrate (3) are removed by the plate material-removing mechanism to regenerate the substrate. In the apparatus shown in Fig. 1, the plate material-removing mechanism includes the plate material-dissolving solution-feeding mechanism (81), the plate material-stripping roller (82) which may be optionally provided, the wash water-feeding mechanism (83), the waste solution suction mechanism (84) and the air-drying mechanism (85).

[0045] First, after the anti-staining tray (86) is disposed between the bracket cylinder (22) and the impression cylinder (23), the plate material-dissolving solution (for example, an aqueous alkali solution) is supplied to the surfaces of the images formed on the photosensitive lithographic plate fitted on the plate cylinder (21) from the plate material-dissolving solution-feeding mechanism (81) while rotating the plate cylinder (21). This procedure allows the images to be dissolved in the solution, thereby regenerating the substrate (3). If the images are not dissolved but swelled, the swelled images are removed by means of the plate material-stripping roller (82) by allowing the images to adhere thereto.

[0046] Then, a wash water is supplied onto the surface of the regenerated substrate (3) from the wash water-feeding mechanism (83). This procedure allows the plate making dissolving solution to be removed from the surface of the substrate (3). Successively, the residual solution still remaining on the substrate (3) is removed by the waste solution suction mechanism (84), and then the surface of the substrate (3) is dried by the air-drying mechanism (85).

[0047] In the present invention, after the regeneration step, the process is returned to the plate making steps (A) to (C), which are then repeated in the same manner. Accordingly, since the respective plate making, printing and regeneration steps are conducted on the printing machine, the working efficiency is considerably enhanced. Besides, in this case, since the plate making is effected on the substrate (3) fixed on the plate cylinder (21), a large modification of the plate cylinder (21) is not particularly needed, and the substrate (3) can be readily replaced with a new one at low costs, resulting in economical advantage.

[0048] In the present invention, by conducting the plate making and regeneration steps, and the printing step on the separate machines, the respective steps can be effectively conducted, and the printing machine is completely prevented from being stained with the liquids used in the plate making and regeneration steps. Further, since the plate making is effected on the substrate fixed on the plate fixing drum, the substrate can be readily replaced with a new one at low costs.

[0049] The process of the present invention can be conducted using the laser plate making and regeneration apparatus (I) as shown in Fig. 2, and the printing machine (II). As the printing machine (II), there may be used conventionally known lithographic printing machines having a printing section including a plate cylinder, a bracket cylinder and an impression cylinder. In the laser plate making and regeneration apparatus (I), the plate making and regeneration steps are repeatedly conducted, whereas in the printing machine (II), the printing step is repeatedly conducted.

[0050] More specifically, the lithographic plate prepared in the plate making and regeneration apparatus (I) is removed from the plate fixing drum (21), fitted to the printing machine (II) (not shown), and then used for printing according to the above procedure. Then, the lithographic plate used for printing is removed from the printing machine (II), and fixed on the plate fixing drum (21), and then the image portions on the lithographic plate are removed by the plate material-removing mechanism to regenerate the substrate. After the regeneration step, the process is returned to the plate making steps (A to C), which are then repeated in the same manner as above.

[0051] In the preferred embodiment of the present invention, the respective steps are conducted under such a condition that the whole part of the plate making apparatus is accommodated within the casing (1) by sliding. In this embodiment of the present invention, the casing (1) is operated as follows. That is, the apparatus (lithographic printing

plates whose surface is coated with a thin film layer composed of the water-soluble polymer by the above undercoating treatment. Specific examples of the water-soluble polymers may include homopolymers or copolymers of hydrophilic monomers having a hydrophilic group such as hydroxyl group, carboxyl group or salts thereof, sulfonic acid group or salts thereof, phosphoric acid group or salts thereof, amido group, amino group and ether group, for example, (meth) acrylic acid ("(meth)acrylic" means "acrylic and/or methacrylic"; this definition is similarly applicable to the following descriptions) or derivatives thereof such as alkali salts and amine salts, itaconic acid or derivatives thereof such as alkali salts and amine salts, 3-vinylpropionic acid or derivatives thereof such as alkali salts and amine salts, vinylsulfonic acid or derivatives thereof such as alkali salts and amine salts, 2-hydroxyethyl (meth)acrylate, 2-sulfoethyl (meth) acrylate, polyoxyethylene glycol mono(meth)acrylate, acid phosphoxy polyoxyethylene glycol mono(meth)acrylate, (meth)acrylamide, N-methylol (meth)acrylamide, N,N-dimethylol (meth)acrylamide, 2-acrylamido-2-methylpropanesulfonic acid, allylamine or halogenated hydroxides thereof, vinyl alcohol or the like.

[0062] The above thin film layer composed of the water-soluble polymer may be formed by coating or spraying an aqueous solution of the above water-soluble polymer onto the surface of the surface-treated aluminum substrate, or dipping the aluminum substrate in the aqueous solution, followed by drying. The thin film layer has a thickness of usually not more than 10 μm.

[0063] The aluminum substrate used for production of the negative-type photosensitive lithographic plate in the present invention preferably has such a property that a gummed tape adhered onto the surface of the aluminum substrate has a peel strength of not more than 500 g/cm. Here, the peel strength of the gummed tape from the aluminum substrate is measured by the following 180° peel test. That is, after adhering a gummed tape ("SLION TAPE3" produced by SILIONTEC CO., LTD.) onto the surface of the substrate at 25°C, 5 kg/cm^2 and 50 cm/min, the substrate adhered with the gummed tape is fixed onto a table, and the gummed tape adhered thereonto is peeled off in the 180° direction at a pulling speed of 30 cm/min. The peel strength is expressed by a linear tension (g/cm) obtained by dividing a maximum stress measured in the above peel test by a width of the gummed tape. In the present invention, the peel strength is preferably not more than 500 g/cm. Also, the peel strength is preferably not less than 1 g/cm, more preferably not less than 10 g/cm. When the peel strength of the gummed tape from the surface of the aluminum substrate is more than the above-specified range, it tends to be difficult to remove the negative images in the below-mentioned regeneration step of the aluminum substrate. On the other hand, when the peel strength is less than the above-specified range, the obtained negative-type lithographic plate tends to be deteriorated in wear resistance upon printing.

[0064] In the present invention, the photosensitive layer formed on the surface of the above aluminum substrate may be constituted from any of positive-type photosensitive compositions and negative-type photosensitive compositions.

[0065] First, the positive-type photosensitive composition constituting the photosensitive layer is explained.

[0066] Among the positive-type photosensitive compositions used in the present invention, preferred are those containing the following components (P-1) and (P-2).

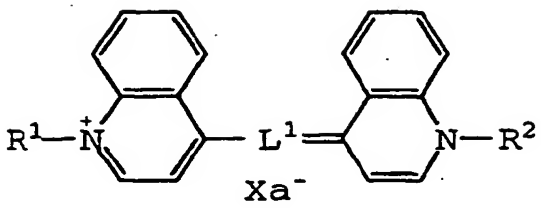
(P-1): alkali-soluble resin;

(P-2): light-heat converting material capable of converting light absorbed from a light source for image exposure into heat.

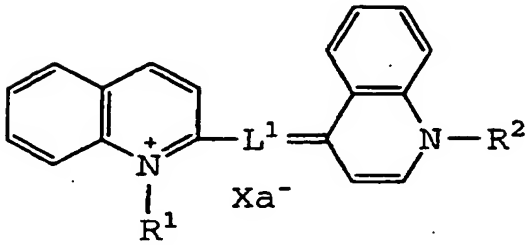
[0067] As the alkali-soluble resin as the component (P-1) constituting the positive-type photosensitive composition, there may be used resins having phenolic hydroxyl group. Specific examples of the resins having phenolic hydroxyl group may include phenol resins such as novolak resins and resole resins, polyvinyl phenol resins, copolymers of acrylic acid derivatives having phenolic hydroxyl group, or the like. Of these resins, preferred are phenol resins such as novolak resins and resole resins as well as polyvinyl phenol resins, and more preferred are phenol resins, and still more preferred are novolak resins.

[0068] The novolak resins are those resins produced by polycondensing at least one of phenols such as, for example, phenol, o-cresol, m-cresol, p-cresol, 2,5-xylenol, 3,5-xylenol, o-ethyl phenol, m-ethyl phenol, p-ethyl phenol, propyl phenol, n-butyl phenol, t-butyl phenol, 1-naphthol, 2-naphthol, 4,4'-biphenyl diol, bisphenol A, pyrocatechol, resorcinol, hydroquinone, pyrogallol, 1,2,4-benzene triol and phloroglucinol with at least one of aldehydes such as, for example, formaldehyde, acetaldehyde, propionaldehyde, benzaldehyde and furfural (para-formaldehyde and paraldehyde may be used instead of formaldehyde and acetaldehyde, respectively), or ketones such as, for example, acetone, methyl ethyl ketone and methyl isobutyl ketone, in the presence of an acid catalyst. In the present invention, among these novolak resins, preferred are those resins produced by polycondensing the phenol selected from phenol, o-cresol, m-cresol, p-cresol, 2,5-xylenol, 3,5-xylenol and resorcinol with the aldehyde or ketone selected from formaldehyde, acetaldehyde and propionaldehyde.

[0069] In particular, there are preferably used resins produced by polycondensing mixed phenols containing m-cresol, p-cresol, 2,5-xylenol, 3,5-xylenol and resorcinol at a mixing molar ratio of 40 to 100:0 to 50:0 to 20:0 to 20:0 to 20, or mixed phenols containing phenol, m-cresol and p-cresol at a mixing molar ratio of 1 to 100:0 to 70:0 to 60, with formaldehyde. Also, as described hereinafter, the photosensitive composition of the present invention may contain an anti-dissolving agent. In this case, there are preferably used resins produced by polycondensing mixed phenols containing m-cresol, p-cresol, 2,5-xylenol, 3,5-xylenol and resorcinol at a mixing molar ratio of 70 to 100:0 to 30:0 to 20:



(Ib)

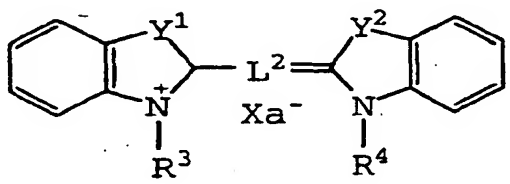


(Ic)

[0077] In the formulae (Ia), (Ib) and (Ic), R^1 and R^2 independently represent an alkyl group which may has a substituent group(s), an alkenyl group which may has a substituent group(s), an alkynyl group which may has a substituent group(s) or a phenyl group which may has a substituent group(s); L^1 represents a tri-, penta-, hepta-nona- or undecamethine group which may has a substituent group(s), in which two substituent groups on the penta-, hepta- nona- or undecamethine group may be bonded to each other to form a C_5 to C_7 cycloalkene ring; the quinoline ring may have substituent groups whose two adjacent groups may be bonded to each other to form a condensed benzene ring; and Xa^- represents a counter anion.

[0078] When R^1 and R^2 in the formulae (Ia), (Ib) thereof therein is usually 1 to 15, preferably 1 to 10. When R^1 and R^2 in the formulae (Ia), (Ib) and (Ic) are an alkenyl group or an alkynyl group, the number of carbon atoms thereof is usually 2 to 15, preferably 2 to 10. Examples of the substituent groups of R^1 and R^2 (including phenyl group) may include usually C_1 to C_{15}, preferably a C_1 to C_{10} alkoxy group, a phenoxy group, hydroxy group, a phenyl group or the like. Examples of the substituent groups of L^1 may include a alkyl group having the same number of carbon atoms as defined above, an amino group, a halogen atom or the like, in which the number of carbon atoms thereof is usually 1 to 15, preferably 1 to 10. Examples of the substituent groups on the quinoline ring may include an alkyl group having the same number of carbon atoms as defined above, an alkoxy group having the same number of carbon atoms as defined above, nitro group, a halogen atom or the like.

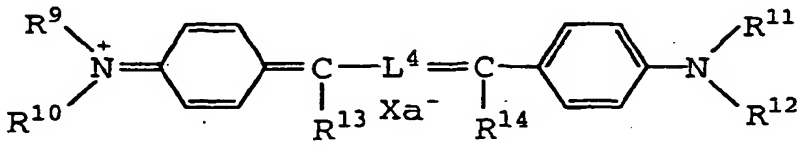
[0079] The preferred indole-based or benzothiazole-based dyes may include, in particular, those represented by the following general formula (II):



(II)

[0080] In the formula (II), Y^1 and Y^2 independently represent a dialkylmethylene group or sulfur atom; R^3 and R^4 independently represent an alkyl group which may has a substituent group(s) an alkenyl group which may has a substituent group(s), an alkynyl group which may has a substituent group(s) or a phenyl group which may has a substituent group(s); L^2 represents a tri-, penta-, hepta-nona- or undecamethine group which may has a substituent group(s), in

[0085] The preferred polymethine-based dyes may include, in particular, those represented by the following general formula (IV):

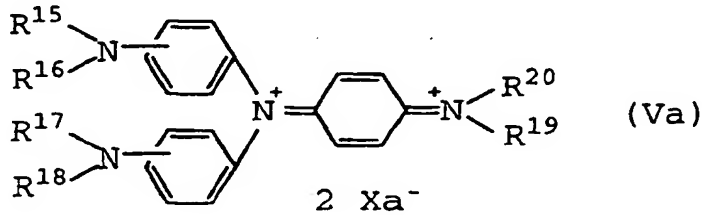


(IV)

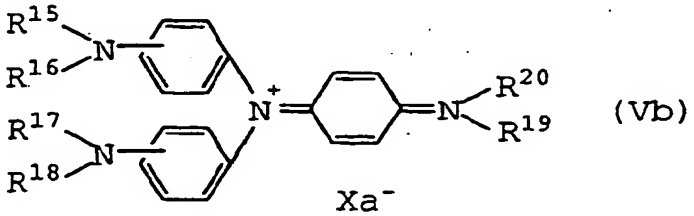
[0086] In the formula (IV), R^9, R^{10}, R^{11} and R^{12} independently represent an alkyl group; R^{13} and R^{14} independently represent an aryl group which has a substituent group(s), a furyl group or thienyl; L^4 represents a mono-, tri-, penta- or heptamethine group which has a substituent group(s), in which two substituent groups on the penta- or heptamethine group may be bonded to each other to form a C_5 to C_7 cycloalkene ring; the quinone ring and the benzene ring may have substituent groups; and Xa^- represents a counter anion.

[0087] The alkyl group as R^9, R^{10}, R^{11} and R^{12} in the formula (IV) has usually 1 to 15, preferably 1 to 10 carbon atoms. When R^{13} and R^{14} are an aryl group, the number of carbon atoms contained therein is usually 6 to 20, preferably 6 to 15. Specific examples of R^{13} and R^{14} may include a phenyl group, a 1-naphthyl group, a 2-naphthyl group, a 2-furyl group, a 3-furyl group, a 2-thienyl group, a 3-thienyl group or the like, and examples of the substituent groups thereof may include an alkyl group having the same number of carbon atoms as defined above, an alkoxy group having the same number of carbon atoms as defined above, a dialkylamino group, hydroxy group, a halogen atom or the like. Examples of the substituent groups of L^4 may include an alkyl group having the same number of carbon atoms as defined above, amino group, a halogen atom or the like. Examples of the substituent groups on the quinone ring and the benzene ring may include an alkyl group having the same number of carbon atoms as defined above, an alkoxy group having the same number of carbon atoms as defined above, nitro group, a halogen atom or the like.

[0088] The preferred diiminium-based dyes may include, in particular, those having at least one N,N-diaryliminium salt skeleton which are represented by the following general formulae (Va) or (Vb):

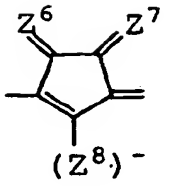


(Va)



(Vb)

[0089] In the formulae (Va) and (Vb), R^{15}, R^{16}, R^{17} and R^{18} independently represent hydrogen atom, a halogen atom, an alkyl group which may has a substituent group(s), an alkenyl group which may has a substituent group(s), an alkynyl group which may has a substituent group(s) or an alkoxy group which may has a substituent group(s); R^{19}

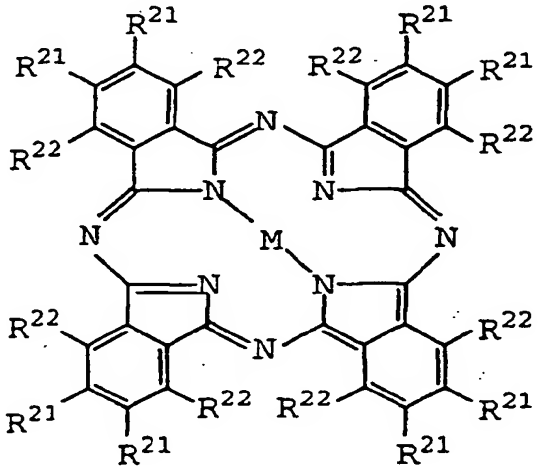


(VIII)

[0094] In the formulae (VI), (VII) and (VIII), Z^3, Z^4, Z^5, Z^6, Z^7 and Z^8 independently represent oxygen atom or sulfur atom and R^{35} and R^{36} independently represent hydrogen atom, an alkyl group which may has a unsubstituent group (s), an alkenyl group which may has a unsubstituent group(s), an alkoxy group which may has a unsubstituent group (s) or a phenyl group which may has a unsubstituent group(s).

[0095] When R^{35} and R^{36} in the formula (VI) are an alkyl group or an alkoxy group, the number of carbon atoms thereof is usually 1 to 15, preferably 1 to 5. When R^{35} and R^{36} in the formula (VI) are an alkenyl group, the number of carbon atoms thereof is usually 2 to 15, preferably 2 to 5. R^{35} and R^{36} are preferably an alkyl group. Specific examples of the alkyl group may include methyl group, ethyl group, propyl group, butyl group or the like.

[0096] The phthalocyanine-based dyes have such a basic structure that heterocyclic rings are bonded to each other through an azapolymethine chain, and the preferred phthalocyanine-based dyes are those represented by the following general formula (IX):



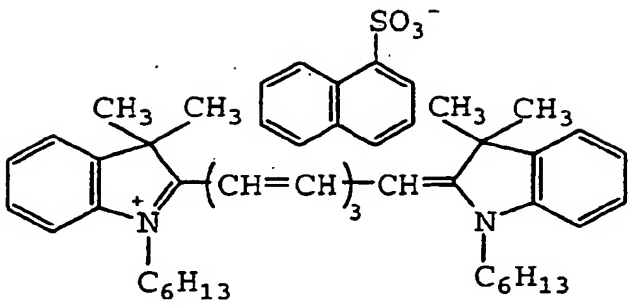
(IX)

[0097] In the formula (IX), R^{21} and R^{22} independently represent an alkoxy group, a thioalkoxy group, an aryloxy group, a thioaryloxy group, an alkylamino group, an arylamino group, halogen atom or hydrogen; M represents Zn, Cu, Ni, $SnCl_2$, AlCl or hydrogen atom; and two adjacent substituent groups bonded to the benzene ring may be bonded to each other to form a condensed ring.

[0098] When R^{21} and R^{22} in the formula (IX) are an alkoxy group, a thioalkoxy group or an alkylamino group, the number of carbon atoms thereof is usually 1 to 10, preferably 1 to 4. Examples of the alkoxy group, a thioalkoxy group and an alkylamino group may include a phenoxy group, a thiophenoxy group, a phenylamino group or the like. Also, M is preferably Zn or $SnCl_2$.

[0099] Among the cyanine-based dyes such as quinoline-based dyes represented by the general formulae (Ia to Ic), indole-based or benzothiazole-based dyes represented by the general formula (II) and pyrilium-based or thiopyrilium-based dyes represented by the general formulae (IIIa to IIIc), the polymethine-based dyes represented by the general formula (IV), the diiminium-based dyes represented by the general formulae (Va and Vb) and the phthalocyanine-based dyes represented by the general formula (IX), preferred are the cyanine-based dyes such as quinoline-based dyes represented by the general formulae (Ia to Ic), indole-based or benzothiazole-based dyes represented by the general formula (II), pyrilium-based or thiopyrilium-based dyes represented by the general formulae (IIIa to IIIc), the polyme-

(II-1)



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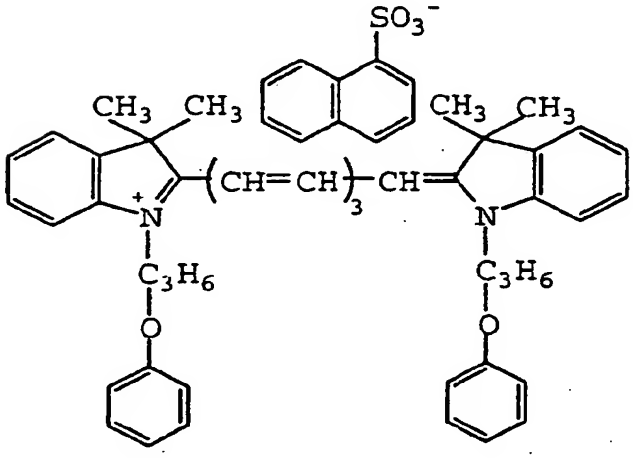

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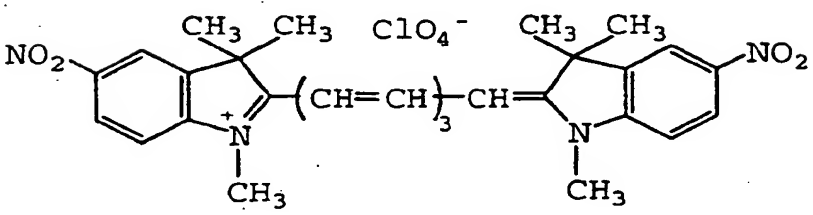

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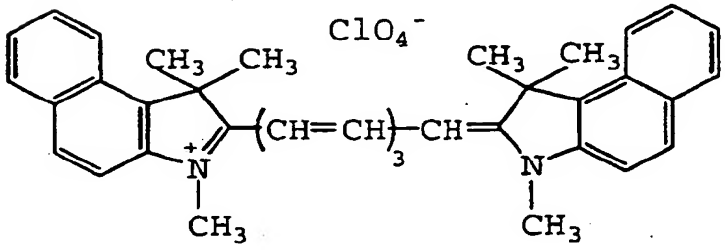

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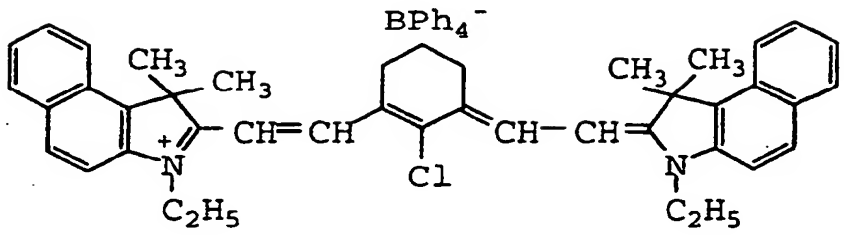

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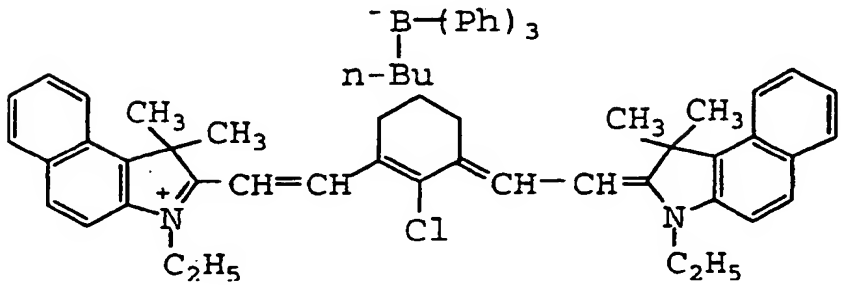

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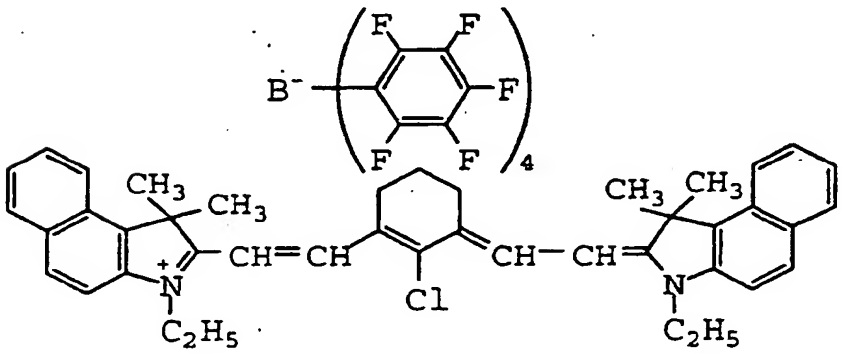
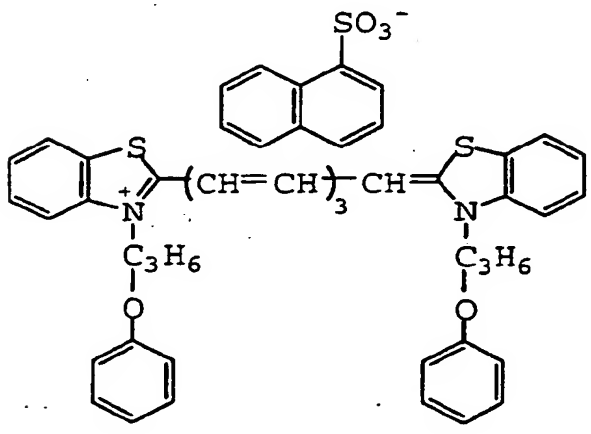
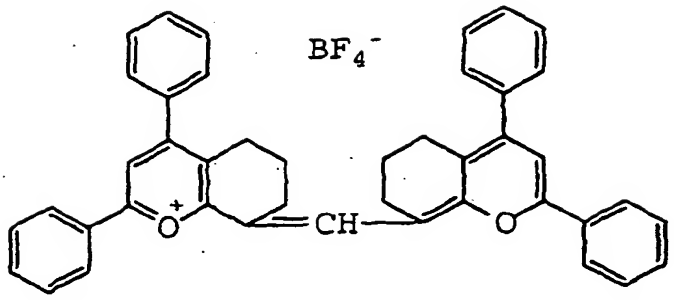


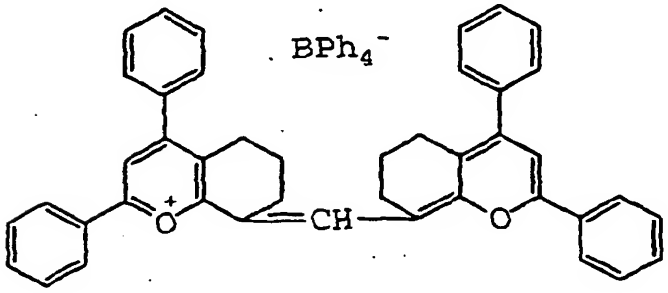
(II-13)



(III-1)



(III-2)



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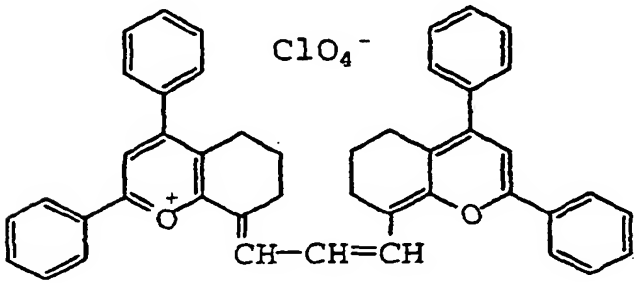
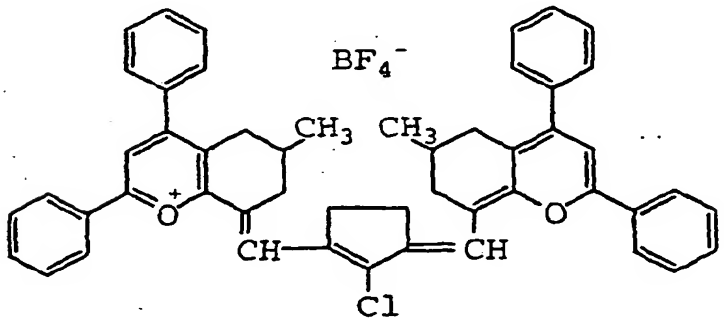
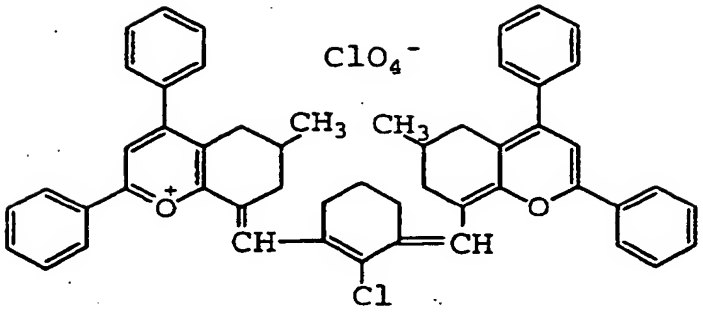


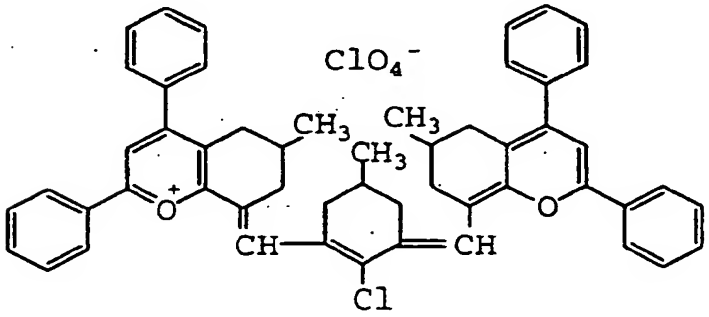
(III-4)



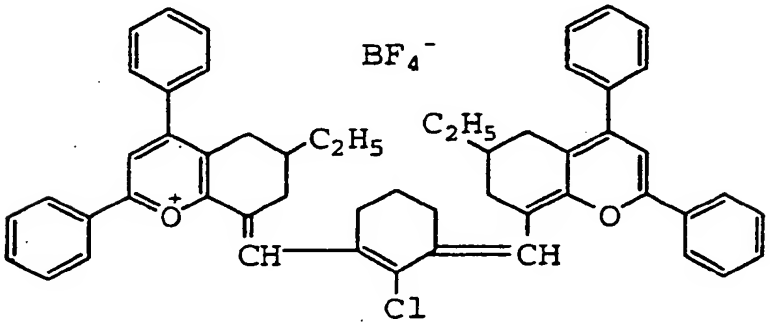
(III-9)



(III-10)



(III-11)



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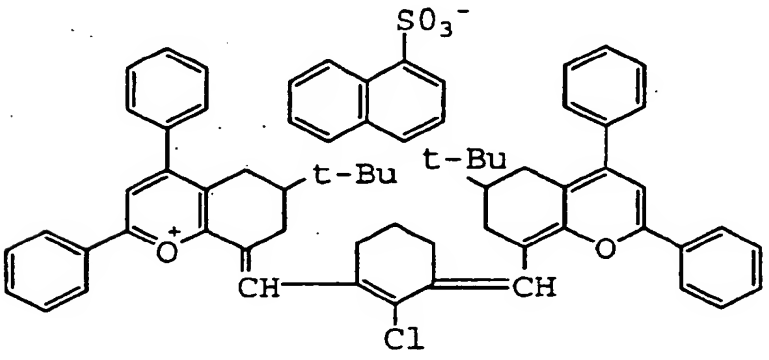

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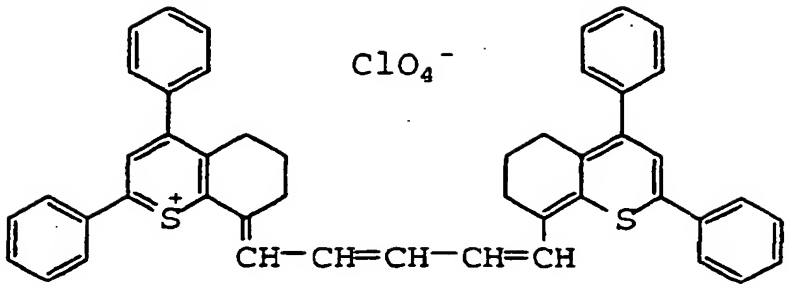

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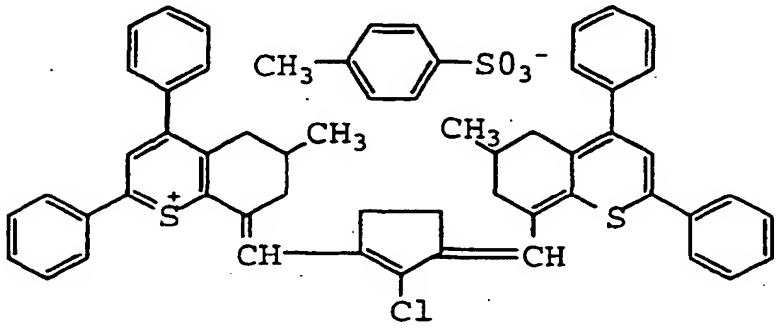

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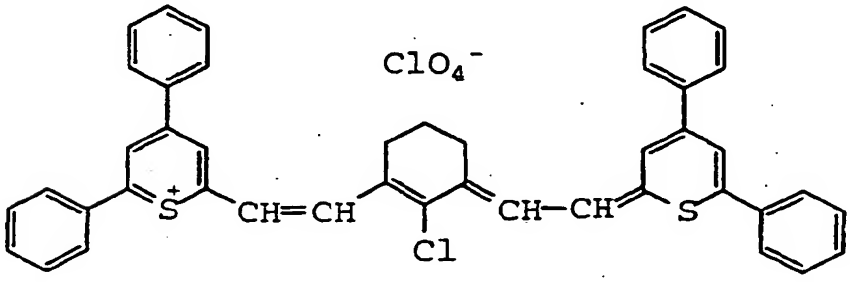

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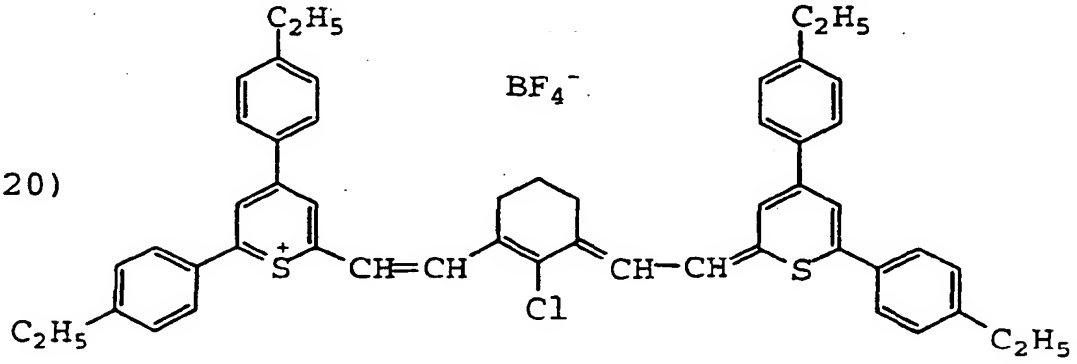
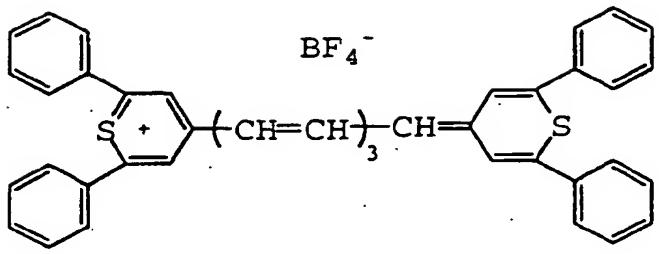
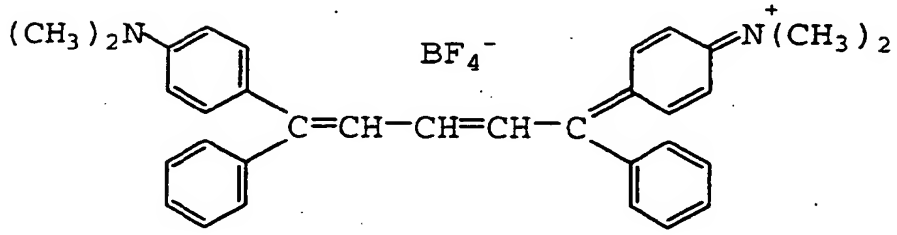


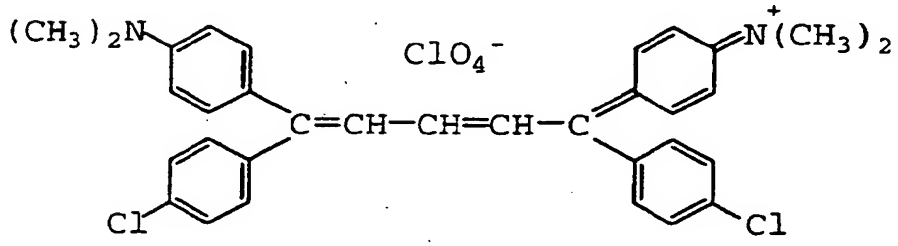
(III-25)



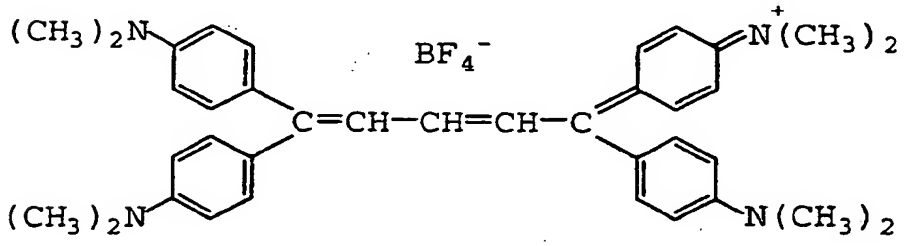
(IV-1)



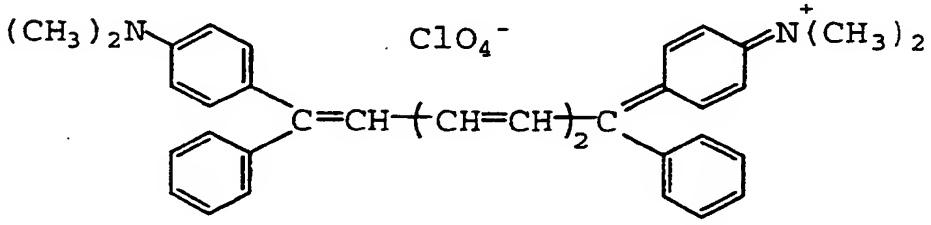
(IV-2)



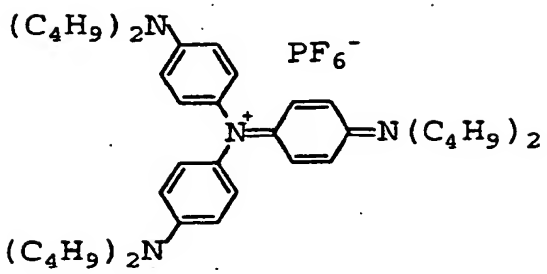
(IV-3)



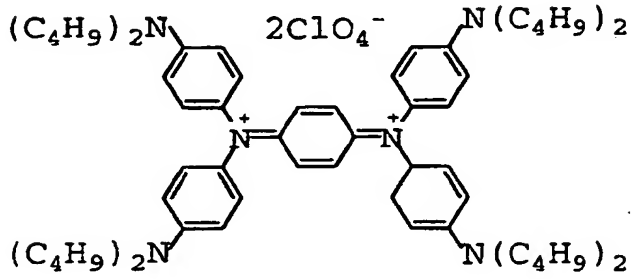
(IV-4)



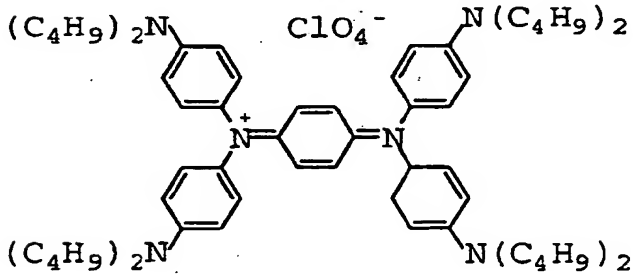
(V-4)



(V-5)



(V-6)



[0101] In the present invention, the content of the alkali-soluble resin as the component (P-1) of the positive-type photosensitive composition is preferably 50 to 99% by weight, more preferably 60 to 98% by weight, still more preferably 70 to 97% by weight. Also, the content of the light-heat converting material as the component (P-2) of the positive-type photosensitive composition is preferably 0.5 to 30% by weight, more preferably 1 to 20% by weight, still more preferably 2 to 10% by weight.

[0102] In addition, for the purpose of increasing the difference in dissolvability to the alkali developing solution between image portion and non-image portion, the above positive-type photosensitive composition may contain an anti-dissolving (solubility-suppressing) agent as the component (P-3) which is not decomposed by infrared light. Examples of the anti-dissolving agent may include sulfonic acid esters, phosphoric acid esters, aromatic carboxylic acid esters, aromatic disulfones, carboxylic anhydrides, aromatic ketones, aromatic aldehydes, aromatic amines, aromatic ethers and compounds having a triarylmethane skeleton as described in Japanese Patent Application Laid-Open (KOKAI) Nos. 10-268512(1998) and 11-288089(1999); acid-developable dyes having a lactone skeleton, N,N-diarylamido skeleton or diarylmethylimino skeleton as described in Japanese Patent Application Laid-Open (KOKAI) No. 11-190903 (1999); base-developable dyes having a lactone skeleton, thiolactone skeleton or sulfolactone skeleton as described in Japanese Patent Application Laid-Open (KOKAI) No. 11-143076(1999); or the like.

[0103] In addition, as the anti-dissolving agent, there may also used nonionic surfactants such as polyethylene glycols, polyethylene glycol polypropylene glycol block copolymers, polyethylene glycol alkyl ethers, polyethylene glycol polypropylene glycol alkyl ethers, polyethylene glycol alkyl phenyl ethers, polyethylene glycol fatty acid esters, polyethylene glycol alkyl amines, polyethylene glycol alkylamino ethers, glycerin fatty acid esters and polyethylene oxide adducts thereof, sorbitan fatty acid esters and polyethylene oxide adducts thereof, sorbitol fatty acid esters and polyethylene oxide adducts thereof, pentaerythritol fatty acid esters and polyethylene oxide adducts thereof, and polyglycerin fatty acid esters.

as ethylene glycol monostearate, ethylene glycol distearate, diethylene glycol stearate, polyethylene glycol distearate, polyethylene glycol monolaurate, polyethylene glycol monostearate and polyethylene glycol monooleate; glycerin fatty acid esters and polyethylene oxide adducts thereof such as glyceryl monomyristate, glyceryl monostearate, glyceryl monoisostearate, glyceryl distearate, glyceryl monooleate and glyceryl dioleate; polyglycerin fatty acid esters; pentaerythritol fatty acid esters and polyethylene oxide adducts thereof such as pentaerythritol monostearate, pentaerythritol tristearate, pentaerythritol monooleate and pentaerythritol trioleate; sorbitan fatty acid esters and polyethylene oxide adducts thereof such as sorbitan monopalmitate, sorbitan monostearate, sorbitan tristearate, sorbitan monooleate and sorbitan trioleate; sorbitol fatty acid esters and polyethylene oxide adducts thereof such as sorbitol monolaurate, sorbitol tetrastearate, sorbitol hexastearate and sorbitol tetraoleate; polyethylene glycol alkyl amines; polyethylene glycol alkylaminoethers; polyethylene oxide adducts of castor oil; polyethylene oxide adducts of lanolin; or the like.

[0113] Examples of the anionic surfactants may include higher fatty acid salts such as sodium laurate, sodium stearate and sodium oleate; alkylsulfonic acid salts such as sodium laurylsulfonate; alkylbenzenesulfonic acid salts such as sodium dodecylbenzenesulfonate; alkylnaphthalenesulfonic acid salts such as sodium isopropylnaphthalenesulfonate; alkyldiphenylethersulfonic acid salts such as sodium alkyldiphenylethersulfonate; polyoxyethylenealkylethersulfonic acid salts such as sodium polyoxyethylenelaurylethersulfonate; salts of alkylsulfuric acid esters such as sodium laurylsulfate and sodium stearylsulfate; salts of higher alcohol sulfuric acid esters such as sodium octyl alcohol sulfate, sodium lauryl alcohol sulfate and ammonium lauryl alcohol sulfate; salts of aliphatic alcohol sulfuric acid esters such as sodium acetyl alcohol sulfate; polyoxyethylenealkylethersulfuric acid salts such as sodium polyoxyethylenelaurylethersulfate, ammonium polyoxyethylenelaurylethersulfate and triethanolamine polyoxyethylenelaurylethersulfate; polyoxyethylenealkylphenylethersulfuric acid salts such as sodium polyoxyethylenenonylphenylethersulfate; salts of alkylphosphoric acid esters such as sodium laurylphosphate and sodium stearylphosphate; polyoxyethylenealkyletherphosphoric acid salts such as sodium polyoxyethylenelauryletherphosphate and sodium polyoxyethylenestearyletherphosphate; polyoxyethylenealkylphenyletherphosphoric acid salts such as sodium polyoxyethylenenonylphenyletherphosphate; sulfosuccinic acids; unsaturated fatty acid sulfated oils; taurine salts; salts of castor oil sulfuric acid esters; or the like.

[0114] Examples of the amphoteric surfactants may include betaine-type compounds such as N-lauryl-N,N-dimethyl-N-carboxymethyl ammonium, N-stearyl-N,N-dimethyl-N-carboxymethyl ammonium, N-lauryl-N,N-dihydroxyethyl-N-carboxymethyl ammonium and N-lauryl-N,N,N-tris(carboxymethyl) ammonium; imidazolium salts such as 2-alkyl-N-carboxymethyl-N-hydroxyethyl imidazolium; imidazolines such as imidazoline-N-sodium ethyl sulfonate and imdazoline-N-sodium ethyl sulfate; aminocarboxylic acids; aminosulfuric acid esters; or the like.

[0115] The content of the above surfactant in the positive-type photosensitive composition of the present invention is preferably 0.001 to 5% by weight, more preferably 0.002 to 3% by weight, still more preferably 0.005 to 1% by weight.

[0116] Further, the positive-type photosensitive composition may contain various additives ordinarily used in the photosensitive composition such as coating modifiers, adhesion modifiers, sensitivity modifiers, sensitizers, development modifiers or the like in an amount of not more than 20% by weight, preferably not more than 10% by weight.

[0117] Meanwhile, the above positive-type photosensitive composition contain no compounds exhibiting a sensitivity to ultraviolet light such as onium salts, diazonium salts and quinonediazido-containing compounds and, therefore, shows substantially no sensitivity to ultraviolet light. Here, the expression "substantially no sensitivity to ultraviolet light" means that the composition has substantially no significant difference in solubility to alkali developing solution between before and after irradiation with a light having a wavelength of 360 to 450 nm, namely the composition shows substantially no practical image forming property upon the irradiation of such light.

[0118] Next, the negative-type photosensitive composition constituting the photosensitive layer is explained.

[0119] Among the negative-type photosensitive compositions used in the present invention, preferred are photopolymerizable compositions containing the following components (N-1) to (N-4):

(N-1) a high-molecular binder;
(N-2) an ethylenically unsaturated compound;
(N-3) a sensitizer; and
(N-4) a photopolymerization initiator.

[0120] The high-molecular binder (N-1) constituting the photopolymerizable composition of the present invention has a function as a binder for the ethylenically unsaturated compound (N-2), the sensitizer (N-3), the photopolymerization initiator (N-4) and the like. Examples of the high-molecular binder may include homopolymers or copolymers of (meth)acrylic acid, (meth)acrylic acid esters, (meth)acrylonitrile, (meth)acrylamide, maleic acid, styrene, vinyl acetate, vinylidene chloride and maleimide, as well as polyimides, polyesters, polyethers, polyurethane, polyvinyl butyral, polyvinyl pyrrolidone, polyethylene oxide and acetyl cellulose. Of these high-molecular binders, carboxyl-containing polymers are preferred from the standpoint of alkali developing property. Specifically, among these carboxyl-containing polymers,

(meth)acrylate, methally (meth)acrylate and N,N-diallyl (meth)acrylamide, with an unsaturated carboxylic acid such as (meth)acrylic acid or with an unsaturated carboxylic acid ester, such that the content of the former compound having at least two kinds of unsaturated groups based on a total amount of the obtained copolymer is about 10 to 90 mol%, preferably about 30 to 80 mol%. In addition, the high-molecular binder having the ethylenically unsaturated bond represented by the above formula (XIIc) on a side chain thereof may be produced by copolymerizing a compound having at least two kinds of unsaturated groups, such as vinyl (meth)acrylate, 1-chlorovinyl (meth)acrylate, 2-phenylvinyl (meth)acrylate, 1-propenyl (meth)acrylate, vinyl crotonate and vinyl (meth)acrylamide, with an unsaturated carboxylic acid such as (meth)acrylic acid or with an unsaturated carboxylic acid ester, such that the content of the former compound having at least two kinds of unsaturated groups based on a total amount of the obtained copolymer is about 10 to 90 mol%, preferably about 30 to 80 mol%.

[0126] Of these high-molecular binders, preferred are alkali-soluble resins; more preferred are carboxyl-containing vinyl-based resins; and still more preferred are those resins having an ethylenically unsaturated bond on a side chain thereof.

[0127] The ethylenically unsaturated compounds as the component (N-2) of the negative-type photosensitive composition of the present invention are compounds containing at least one radical polymerizable ethylenically unsaturated bond in a molecule which are addition-polymerized, and in some cases cross-linked and cured, by the effect of a photopolymerization initiation system containing the below-mentioned photopolymerization initiator (N-4) when irradiating active rays to the composition.

[0128] As the ethylenically unsaturated compounds, there may be used those compounds having one ethylenically unsaturated bond in a molecule, for example, unsaturated carboxylic acids such as (meth)acrylic acid, crotonic acid, isocrotonic acid, maleic acid, itaconic acid and citraconic acid or alkyl esters thereof, as well as (meth)acrylonitrile, (meth)acrylamide, styrene or the like. However, from the standpoints of good polymerizability and cross-linking property as well as increased difference of solubility in developing solution between exposed and non-exposed portions, there are preferably used compounds having two or more ethylenically unsaturated bonds in a molecule. Of these compounds, more preferred are acrylate compounds having unsaturated bonds derived from (meth)acryloyloxy groups.

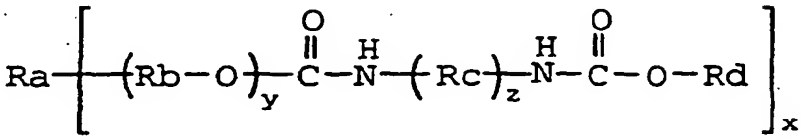
[0129] Typical examples of the compounds having two or more ethylenically unsaturated bonds in a molecule may include esters of unsaturated carboxylic acids and polyhydroxy compounds; (meth)acryloyloxy-containing phosphates; urethane (meth)acrylates of hydroxy (meth)acrylate compounds and polyisocyanate compounds; epoxy (meth)acrylates of (meth)acrylic acid or hydroxy (meth)acrylate compounds and polyepoxy compounds; or the like.

[0130] The esters of unsaturated carboxylic acids and polyhydroxy compounds may be reaction products obtained, for example, by reacting the above unsaturated carboxylic acid with an aliphatic polyhydroxy compound such as ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, propylene glycol, tripropylene glycol, trimethylene glycol, tetramethylene glycol, neopentyl glycol, hexamethylene glycol, nonamethylene glycol, trimethylol ethane, tetramethylol ethane, trimethylol propane, glycerol, pentaerythritol, dipentaerythritol, sorbitol, ethylene oxide adducts thereof and propylene oxide adducts thereof as well as diethanol amine, triethanol amine, etc. Specific examples of the esters of unsaturated carboxylic acids and polyhydroxy compounds may include ethylene glycol di(meth)acrylate, diethylene glycol di(meth)acrylate, triethylene glycol di(meth)acrylate, tetraethylene glycol di(meth)acrylate, propylene glycol di(meth)acrylate, tripropylene glycol di(meth)acrylate, tetramethylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate, hexamethylene glycol di(meth)acrylate, nonamethylene glycol di(meth)acrylate, trimethylolethane tri(meth)acrylate, tetramethylolethane tri(meth)acrylate, trimethylolpropane di(meth)acrylate, trimethylolpropane tri(meth)acrylate, trimethylolpropane ethylene oxide-added tri(meth)acrylate, glycerol di(meth)acrylate, glycerol tri(meth)acrylate, glycerol propylene oxide-added tri(meth)acrylate, pentaerythritol di(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol di(meth)acrylate, dipentaerythritol tri(meth)acrylate, dipentaerythritol tetra(meth)acrylate, dipentaerythritol penta(meth)acrylate, dipentaerythritol hexa(meth)acrylate, sorbitol tri(meth)acrylate, sorbitol tetra(meth)acrylate, sorbitol penta(meth)acrylate, sorbitol hexa(meth)acrylate, and similar crotonates, isocrotonates, maleates, itaconates and citraconates, which are of the same sorts.

[0131] Examples of the further suitable esters may include reaction products obtained by reacting the above unsaturated carboxylic acid with an aromatic polyhydroxy compound such as hydroquinone, resorcin, pyrogallol, bisphenol F and bisphenol A, e.g., hydroquinone di(meth)acrylate, resorcin di(meth)acrylate, pyrogallol tri(meth)acrylate, etc.; reaction products obtained by reacting the above unsaturated carboxylic acid with a heterocyclic polyhydroxy compound such as tris(2-hydroxyethyl)isocyanurate, e.g., di(meth)acrylate or tri(meth)acrylate of tris(2-hydroxyethyl)isocyanurate; reaction products obtained by reacting an unsaturated carboxylic acid, a polycarboxylic acid and a polyhydroxy compound with each other, e.g., condensates of (meth)acrylic acid, phthalic acid and ethylene glycol, condensates of (meth)acrylic acid, maleic acid and diethylene glycol, condensates of (meth)acrylic acid, terephthalic acid and pentaerythritol, condensates of (meth)acrylic acid, adipic acid, butane diol and glycerin, or the like.

[0132] The (meth)acryloyloxy-containing phosphates are not particularly restricted as long as they are phosphate compounds having a (meth)acryloyloxy group. Of these phosphate compounds, preferred are those represented by the following general formula (Ia) or (Ib):

[0139] In the present invention, of these urethane (meth)acrylates, especially preferred are those represented by the following general formula (II):

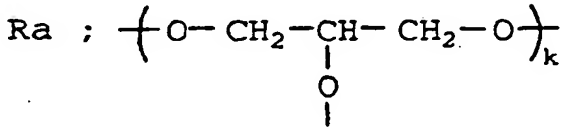


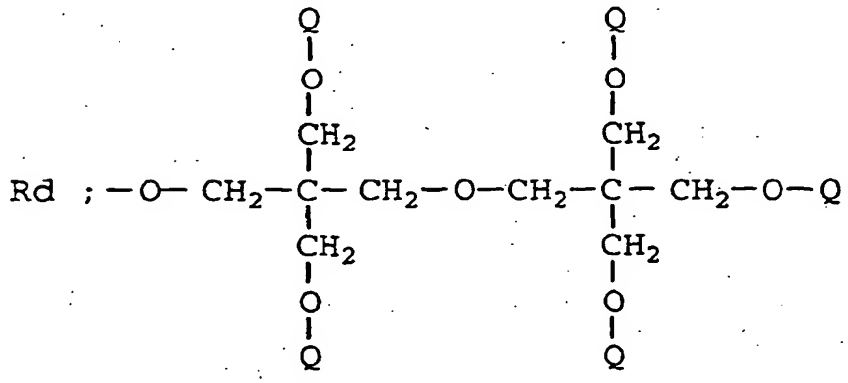
(II)

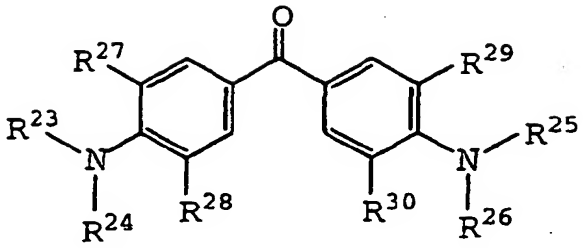
[0140] In the formula (II), Ra represents a group having a repeated structure of an alkyleneoxy group or an aryleneoxy group and 4 to 20 oxy group capable of bonding to Rb; Rb and Rc independently represent a C_1 to C_{10} alkylene group; Rd represents an organic residue having a 1 to 10 (meth)acryloyloxy group; Ra, Rb, Rc and Rd may have a substituent group(s); x is an integer of 4 to 20; y is an integer of 0 to 15; and z is an integer of 1 to 15.

[0141] Examples of the repeated structure of alkyleneoxy groups of Ra in the formula (II) may include those derived from propylene triol, glycerin, pentaerythritol or the like. Also, examples of the repeated structure of aryleneoxy groups of Ra in the formula (II) may include those derived from pyrogallol, 1,3,5-benzene triol or the like. The alkylene groups of Rb and Rc respectively have preferably 1 to 5 carbon atoms; the (meth)acryloyloxy group of Rd has preferably 1 to 7 carbon atoms; and x is preferably 4 to 15, y is preferably 1 to 10, and z is preferably 1 to 10.

[0142] More preferably, Ra is represented by the following formula wherein k is an integer of 2 to 10; Rb and Rc independently represent dimethylene group, monomethyldimethylene group or trimethylene group; and Rd is represented by the following formula.





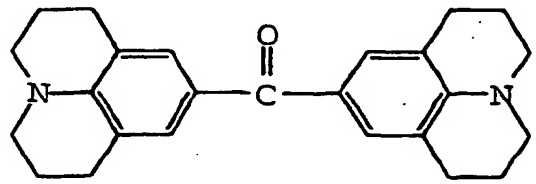


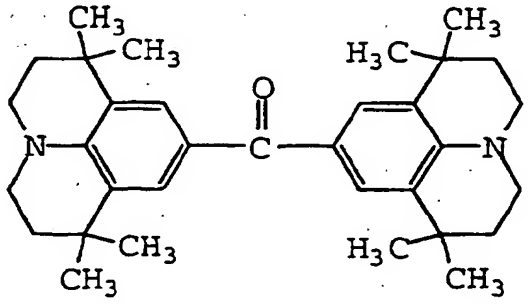
(Xa)

[0150] In the formula (Xa), R^{23}, R^{24}, R^{25} and R^{26} independently represent an alkyl group; and R^{27}, R^{28}, R^{29} and R^{30} independently represent an alkyl group or hydrogen atom wherein R^{23} and R^{24}, R^{25} and R^{26}, R^{23} and R^{27}, R^{24} and R^{28}, R^{25} and R^{29}, and R^{26} and R^{30} may respectively form a nitrogen-containing heterocyclic ring.

[0151] The alkyl group as R^{23}, R^{24}, R^{25} and R^{26} as well as R^{27}, R^{28}, R^{29} and R^{30} in the formula (Xa) preferably has 1 to 6 carbon atoms. Also, The nitrogen-containing heterocyclic ring formed by these groups is preferably a 5- or 6-membered ring. more preferably a 6-membered ring.

[0152] Specific examples of the compounds represented by the general formula (Xa) may include 4,4'-bis(dimethylamino) benzophenone, 4,4'-bis(diethylamino) benzophenone, and compounds having the following structural formulae:



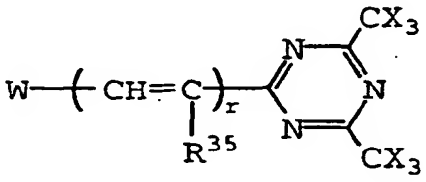


represented by the general formula (Xb), may include 2-(p-dimethylaminophenyl)pyridine, 2-(p-diethylaminophenyl) pyridine, 2-(p-dimethylaminophenyl)quinoline, 2-(p-diethylaminophenyl)quinoline, 2-(p-dimethylaminophenyl)pyrimidine, 2-(p-diethylaminophenyl)pyrimidine, 2,5-bis(p-diethylaminophenyl)-1,3,4-oxadiazole, 2,5-bis(p-diethylaminophenyl)-1,3,4-thiadiazole, or the like.

[0158] Further, as the sensitizers there may be used triphenylmethane-based leuco dyes as described in USP No. 3,479,185, such as leuco crystal violet and leuco malachite green; photoreducing dyes such as erythrosin and eosin Y; aminophenyl ketones described in USP Nos. 3,549,367, and 3,652,275 such as Michler's ketone and aminostyryl ketone; β-diketones as described in USP No. 3,844,790; imidanones as described in USP No. 4,162,162; coumarin-based dyes as described in Japanese Patent Application Laid-Open (KOKAI) Nos. 6-301208(1994), 8-129258(1994), 8-129259(1994), 8-146605(1994) and 8-211605(1994); ketocoumarin-based dyes as described in Japanese Patent Application Laid-Open (KOKAI) No. 52-112681(1977); aminostyrene derivatives or aminophenyl butadiene derivatives as described in Japanese Patent Application Laid-Open (KOKAI) No. 59-56403(1984); aminophenyl heterocyclic compounds as described in USP No. 4,594,310; durolysine heterocyclic compounds as described in USP No. 4,966,830; pyromethene-based dyes as described in Japanese Patent Application Laid-Open (KOKAI) Nos. 5-241338(1993), 7-5685(1995) and 10-144242(1998); or the like.

[0159] Also, the photopolymerization initiator as the component (N-4) of the negative-type photosensitive composition is a radical generator capable of generating active radicals when the composition is irradiated with light under the coexistence of the above sensitizer (N-3). Typical examples of the photopolymerization initiator may include halomethylated s-triazine derivatives, halomethylated 1,3,4-oxadiazole derivatives, hexaarylbiimidazole derivatives, titanocene derivatives, organoboric acid salts, diaryl iodium salts, carbonyl compounds, organic peroxides or the like. Of these photopolymerization initiators, preferred are halomethylated s-triazine derivatives, hexaarylbiimidazole derivatives and organoboric acid salts.

[0160] The halomethylated s-triazine derivatives are preferably those derivatives having at least one mono-, di-or tri-halogen-substituted methyl group bonded to the s-triazine ring, more preferably those compounds represented by the following general formula (X):



(X)

[0161] In the formula (X), R^{35} represents hydrogen atom, a halogen atom, an alkyl group or an aryl group; W represents an aryl group which may has a substituent group(s) or a heterocyclic group; X is halogen atom; and r is an integer of 0 to 2.

[0162] Specific examples of the halomethylated s-triazine derivatives may include 2-methyl-4,6-bis(trichloromethyl)-s-triazine, 2-n-propyl-4,6-bis(trichloromethyl)-s-triazine, 2-(α,α,β-trichloroethyl)-4,6-bis(trichloromethyl)-s-triazine, 2-phenyl-4,6-bis(trichloromethyl)-s-triazine. 2-(p-methoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine, 2-(3,4-epoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine, 2-(p-chlorophenyl)-4,6-bis(trichloromethyl)-s-triazine, 2-[1-(p-methoxyphenyl)-2,4-butadienyl]-4,6-bis(trichloromethyl)-s-triazine, 2-styryl-4,6-bis(trichloromethyl)-s-triazine, 2-(p-methoxystyryl)-4,6-bis(trichloromethyl)-s-triazine, 2- (pi-propyloxystyryl)-4,6-bis(trichloromethyl)-s-triazine, 2-(p-tolyl)-4,6-bis(trichloromethyl)-s-triazine, 2-(p-methoxynaphthyl)-4,6-bis(trichloromethyl)-s-triazine, 2-(p-ethoxynaphthyl)-4,6-bis(trichloromethyl)-s-triazine, 2-(p-ethoxycarbonylnaphthyl)-4,6-bis(trichloromethyl)-s-triazine, 2-phthylthio-4,6-bis(trichloromethyl)-s-triazine, 2-benzylthio-4,6-bis(trichloromethyl)-s-triazine, 2-methyl-4,6-bis(tribromomethyl)-s-triazine, 2-methoxy-4,6-bis(tribromomethyl)-s-triazine or the like. Of these halomethylated s-triazine derivatives, preferred are 2-methyl-4,6-bis(trichloromethyl)-s-triazine, 2-phenyl-4,6-bis(trichloromethyl)-s-triazine, 2-(p-methoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine. 2-(3,4-epoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine, 2-[1-(p-methoxyphenyl)-2,4-butadienyl]-4,6-bis(trichloromethyl)-s-triazine, 2- (p-methoxystyryl)-4,6-bis(trichloromethyl)-s-triazine, 2-(p-i-propyloxystyryl)-4,6-bis(trichloromethyl)-s-triazine and the like.

[0163] Specific examples of the halomethylated 1,3,4-oxadiazole derivatives may include 2-(p-methoxyphenyl)-5-trichloromethyl-1,3,4-oxadiazole, 2-(p-methoxystyryl)-5-trichloromethyl-1,3,4-oxadiazole, 2-(o-benzofuryl)-5-trichloromethyl-1,3,4-oxadiazole, 2-[β-(o-benzofuryl)vinyl] -5-trichloromethyl-1,3,4-oxadiazole or the like.

[0164] Specific examples of the hexaarylbiimidazole derivatives may include 2,2'-bis(o-methoxyphenyl)-4,4',5,5'-tetraphenylbiimidazole, 2,2'-bis(p-methoxyphenyl)-4,4',5,5'-tetraphenylbiimidazole, 2,2'-bis(o-chlorophenyl)-4,4',5,5'-tet-

cation of the organoboric acid salt and an appropriately selected counter cation therein as well as the method of blending a salt formed from organoboron cation of the organoboric acid salt and dye cation of the sensitizer (N-3) therein.

[0171] In the present invention, the contents of the alkali-soluble resin (N-1), the ethylenically unsaturated compound (N-2), the sensitizer (N-3) and the polymerization initiator (N-4) in the negative-type photosensitive composition are as follows. That is, the content of the alkali-soluble resin (N-1) is preferably 10 to 400 parts by weight, more preferably 20 to 200 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2). The content of the sensitizer (N-3) is preferably 0.01 to 20 parts by weight, more preferably 0.05 to 10 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2). The content of the photopolymerization initiator (N-4) is preferably 0. 1 to 80 parts by weight, more preferably 0. 5 to 60 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2).

[0172] In addition, the negative-type photosensitive composition may contain a hydrogen-donating compound (N-5) for the purpose of improving a photopolymerization initiating capability thereof. Examples of the hydrogen-donating compound may include mercapto-containing compounds such as 2-mercaptobenzothiazole, 2-mercaptobenzoimidazole, 2-mercaptobenzoxazole, 3-mercapto-1,2,4-triazole, 2-mercapto-4(3H)-quinazoline, β-mercaptonaphthalene, ethylene glycol dithiopropionate, trimethylolpropane tristhiopropionate and pentaerythritol tetrakisthiopropionate; polyfunctional thiol compounds such as hexane dithiol, trimethylolpropane tristhioglyconate and pentaerythritol tetrakisthiopropionate, aromatic ring-containing amino acids or derivatives thereof such as N,N-dialkylaminobenzoic acid ester, N-phenyl glycin or its derivatives including its salts, e.g., ammonium salts and sodium salts, and its esters, and phenyl alanine or its derivatives including its salts, e.g., ammonium salts or sodium salts, and its esters; or the like. Of these hydrogen-donating compounds, preferred are mercapto-containing compounds, and N-phenyl glycin or its derivatives including its salts, e.g., ammonium salts and sodium salts, and its esters.

[0173] In the present invention, the content of the hydrogen-donating compound (N-5) in the negative-type photosensitive composition is preferably 0.1 to 50 parts by weight, more preferably 0.5 to 30 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2).

[0174] Also, the negative-type photosensitive composition may contain an amine compound (N-6) in order to impart a good keeping stability thereto. As the amine compound, there may be used aliphatic, alicyclic or aromatic amines. The amine compounds may be in the form of not only monoamines but also polyamines such as diamines or triamines, and in the form of primary, secondary or tertiary amines. Of these amine compounds, preferred are those amine compounds having a pKb value of not more than 7.

[0175] Specific examples of the amine compounds may include aliphatic amines which may be substituted with hydroxyl or phenyl, such as butyl amine, dibutyl amine, tributyl amine, amyl amine, diamyl amine, triamyl amine, hexyl amine, dihexyl amine, trihexyl amine, allyl amine, diallyl amine, triallyl amine, triethanol amine, benzyl amine, dibenzyl amine and tribenzyl amine. Of these amine compounds, preferred are tribenzyl amine.

[0176] In the present invention, the content of the amine compound (N-6) in the negative-type photosensitive composition is preferably 0.1 to 20 parts by weight, more preferably 0.5 to 10 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2).

[0177] Further, the negative-type photosensitive composition may contain various additives, for example, a thermal polymerization inhibitor such as hydroquinone, p-methoxy phenol and 2,6-di-t-butyl-p-cresol in an amount of not more than 2 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2); a colorant composed of organic or inorganic dyes and pigments in an amount of not more than 20 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2); a plasticizer such as dioctyl phthalate, didodecyl phthalate and tricresyl phosphate in an amount of not more than 40 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2); a sensitivity modifier such as tertiary amines and thiols, a coating modifier such as fluorine-based surfactants and a development accelerator, respectively, in an amount of not more than 10 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2); and a dye precursor in an amount of not more than 30 parts by weight based on 100 parts by weight of the ethylenically unsaturated compound (N-2).

[0178] In the present invention, the above photosensitive composition may be used in the form of a solution or a dispersion prepared by dissolving or dispersing the respective components in a suitable solvent. The thus obtained solution or dispersion is coated on the surface of the aluminum substrate, heated and then dried to form a photosensitive layer composed of the photosensitive composition on the surface of the aluminum substrate, thereby obtaining a photosensitive lithographic plate.

[0179] The solvent used above is not particularly restricted as long as it has a sufficient solubility in the components used in the photosensitive composition as well as a good coating property. Examples of the solvent may include cellosolve-based solvents such as methyl cellosolve, ethyl cellosolve, methyl cellosolve acetate and ethyl cellosolve acetate; propylene glycol-based solvents such as propylene glycol monomethyl ether, propylene glycol monoethyl ether, propylene glycol monobutyl ether, propylene glycol monomethyl ether acetate, propylene glycol monoethyl ether acetate, propylene glycol monobutyl ether acetate and dipropylene glycol dimethyl ether; ester-based solvents such as

indium gallium nitride semiconductor laser emitting laser light with a wavelength of 410 nm as the former type laser, and the semiconductor laser emitting laser light with a wavelength of 1,064 nm and YAG laser emitting laser light with a wavelength of 830 nm as the latter type laser, though not particularly limited thereto.

[0190] Also, although the scanning exposure method is not particularly restricted, examples of the scanning exposure method may include plane scanning exposure method, outer surface drum scanning exposure method, inner surface drum scanning exposure method or the like. The output light intensity in the former wavelength range of 400 to 420 nm is usually 1 to 100 mW, preferably 3 to 70 mW, and the output light intensity in the latter wavelength range of 600 to 1,300 nm is usually 0.1 to 100 mW, preferably 0.5 to 70 mW; the beam spot diameter in both the former and latter wavelength ranges is usually 2 to 30 μm, preferably 4 to 20 μm; and the scanning speed in the former wavelength range is usually 50 to 500 m/sec, preferably 100 to 400 m/sec, and the scanning speed in the latter wavelength range is usually 0.1 to 500 m/sec, preferably 0.3 to 400 m/sec. In addition, the scanning exposure may be conducted such that the laser exposure amount on the photosensitive layer is usually 1 to 100 $\mu J/cm^2$, preferably 5 to 50 $\mu J/cm^2$ in the former wavelength range, and usually 1 to 200 mJ/cm^2, preferably 5 to 150 mJ/cm^2 in the latter wavelength range.

[0191] The development treatment after the above laser scanning exposure may be conducted using an alkali developing solution. As the alkali developing solution, there may used, for example, an aqueous solution containing about 0.1 to 5% by weight of an inorganic alkali salt such as sodium silicate, potassium silicate, lithium silicate, ammonium silicate, sodium metasilicate, potassium metasilicate, sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium carbonate, sodium hydrogen carbonate, potassium carbonate, sodium secondary phosphate, sodium tertiary phosphate, ammonium secondary phosphate, ammonium tertiary phosphate, sodium borate, potassium borate and ammonium borate, or an organic amine compound such as monomethyl amine, dimethyl amine, trimethyl amine, monoethyl amine, diethyl amine, triethyl amine, monoisopropyl amine, diisopropyl amine, monobutyl amine, monoethanol amine, diethanol amine, triethanol amine, monoisopropanol amine and diisopropanol amine.

[0192] Among them, preferred alkali developing solutions usable for production of the positive-type lithographic plate are those containing an alkali metal silicate as an inorganic alkali salt such as sodium silicate and potassium silicate. Further, it is preferred that the alkali developing solution contains the alkali metal silicate in an amount of 0.1 to 5% by weight (calculated as silicon dioxide), and the molar ratio ($[SiO_2]/[M]$) of silicon dioxide ($[SiO_2]$) to alkali metal ([M]) is 0.1 to 1.5, and it is more preferred that the alkali developing solution contains the alkali metal silicate in an amount of 0.2 to 3% by weight (calculated as silicon dioxide), and the molar ratio ($[SiO_2]/[M]$) of silicon dioxide ($[SiO_2]$) to alkali metal ([M]) is 0.2 to 1.0.

[0193] Also, the alkali developing solution may preferably contain a nonionic, anionic, cationic or amphoteric surfactant in order to attain stable broader developing conditions.

[0194] Specific examples of the nonionic surfactant may include alcohols such as cetanol, stearyl alcohol, behenyl alcohol, ethylene glycol and glycerin; polyethylene glycols such as polyethylene glycol and polyethylene glycol polypropylene glycol block copolymer: polyethylene glycol alkyl ethers such as polyethylene glycol cetyl ether, polyethylene glycol stearyl ether, polyethylene glycol oleyl ether and polyethylene glycol behenyl ether; polyethylene glycol polypropylene glycol alkyl ethers such as polyethylene glycol polypropylene glycol cetyl ether and polyethylene glycol polypropylene glycol decyltetradecyl ether; polyethylene glycol alkylphenyl ethers such as polyethylene glycol octylphenyl ether and polyethylene glycol nonylphenyl ether; polyethylene glycol fatty acid esters such as ethylene glycol monostearate, ethylene glycol distearate, diethylene glycol stearate, polyethylene glycol distearate, polyethylene glycol monolaurate, polyethylene glycol monostearate and polyethylene glycol monooleate; glycerin fatty acid esters and polyethylene oxide adducts thereof such as glyceryl monomyristate, glyceryl monostearate, glyceryl monoisostearate, glyceryl distearate, glyceryl monooleate and glyceryl dioleate; pentaerythritol fatty acid esters and polyethylene oxide adducts thereof such as pentaerythritol monostearate, pentaerythritol tristearate, pentaerythritol monooleate and pentaerythritol trioleate; sorbitan fatty acid esters and polyethylene oxide adducts thereof such as sorbitan monopalmitate, sorbitan monostearate, sorbitan tristearate, sorbitan monooleate and sorbitan trioleate; sorbitol fatty acid esters and polyethylene oxide adducts thereof such as sorbitol monolaurate, sorbitol tetrastearate, sorbitol hexastearate and sorbitol tetraoleate; polyethylene glycol alkyl amines; polyethylene glycol alkylamino ethers; polyethylene oxide adducts of castor oil; polyethylene oxide adducts of lanolin; or the like. Of these nonionic surfactants, preferred are alcohols, polyethylene glycol polypropylene glycol alkyl ethers and polyethylene glycol alkylphenyl ethers.

[0195] Specific examples of the anionic surfactant may include higher fatty acid salts such as sodium laurate, sodium stearate and sodium oleate; alkylsulfonic acid salts such as sodium laurylsulfonate; alkylbenzenesulfonic acid salts such as sodium dodecylbenzenesulfonate; alkylnaphthalenesulofonic acid salts such as sodium isopropylnaphthalenesulfonate; alkyl diphenyl ether disulfonic acid salts such as sodium alkyl diphenyl ether disulfonate; polyoxyethylene alkyl ether sulfonic acid salts such as sodium polyoxyethylene lauryl ether sulfonate; salts of alkyl sulfuric acid esters such as sodium lauryl sulfate and sodium stearyl sulfate; salts of higher alcohol sulfuric acid esters such as sodium octyl alcohol sulfate, sodium lauryl alcohol sulfate and ammonium lauryl alcohol sulfate; salts of aliphatic alcohol sulfuric acid esters such as sodium acetyl alcohol sulfate; polyoxyethylene alkyl ether sulfuric acid salts such as sodium polyoxyethylene lauryl ether sulfate, ammonium polyoxyethylene lauryl ether sulfate and triethanolamine polyoxyethylene

erably an aqueous solution containing a water-soluble organic solvent in addition to the alkali agent and the surfactant. The above alkali agent largely contributes to release of the photosensitive images, whereas the surfactant and the water-soluble organic solvent have a function for swelling the photosensitive layer and allowing the alkali agent to be penetrated thereinto.

[0204] As the alkali agent contained in the release agent, there may be used, for example, an alkali developing solution composed of an aqueous solution containing an inorganic alkali salt such as sodium silicate, potassium silicate, lithium silicate, ammonium silicate, sodium metasilicate, potassium metasilicate, sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium carbonate, sodium hydrogen carbonate, potassium carbonate, sodium secondary phosphate, sodium tertiary phosphate, ammonium secondary phosphate, ammonium tertiary phosphate, sodium borate, potassium borate and ammonium borate, or an organoamine compound such as monomethyl amine, dimethyl amine, trimethyl amine, monoethyl amine, diethyl amine, triethyl amine, monoisopropyl amine, diisopropyl amine, monobutyl amine, monoethanol amine, diethanol amine, triethanol amine, monoisopropanol amine and diisopropanol amine in an amount of usually 0.01 to 20% by weight, preferably 0.1 to 10% by weight, more preferably 0.1 to 5% by weight. Of these alkali agents, preferred are organoamine compounds such as triethanol amine and diethanol amine.

[0205] As the surfactant contained in the release agent, there may be used various anionic, nonionic, cationic and amphoteric surfactants. Examples of the anionic surfactants may include fatty acid salts such as sodium laurylsulfate (Emal 0), sodium higher alcohol sulfate (Emal 40 Paste), triethanolamine laurylsulfate (Emal TD), ammonium laurylsulfate (Emal AD•25R), sodium dodecylbenzenesulfonate (Neoberex No. 25); alkylsulfuric acid ester salts; and alkylbenzenesulfonic acid salts.

[0206] Examples of the anionic surfactants may include alkylnaphthalenesulfonic acid salts such as sodium alkylnaphthalenesulfonate (Berex NB•L), sodium dialkylsulfosuccinate (Berex OT•P), sodium alkyl diphenyl ether disulfonate (Berex SS•L), potassium alkylphosphonate (Electrostripper F), sodium polyoxyethylene lauryl ether sulfate (Emal 20C), triethanolamine polyoxyethylene alkyl ether sulfate (Emal 20T) and polyoxyethylene alkyl aryl ether (Levenol WZ); alkylsulfosuccinic acid salts; and alkyl diphenyl ether disulfonic acid salts. Examples of the further anionic surfactants may include naphthalenesulfonic acid formalin condensates such as a sodium salt of β-naphthalenesulfonic acid formalin condensate (Demol N), a sodium salt of special aromatic sulfonic acid formalin condensate (Demol MS), special polycarboxylic acid type high molecular weight surfactant (Demol EP); other special polycarboxylic acid type high molecular weight surfactants; or the like.

[0207] Examples of the nonionic surfactants may include polyoxyethylene alkyl ethers and polyoxyethylene alkyl aryl ethers such as polyoxyethylene lauryl ether (Emalgen 104P), polyoxyethylene cetyl ether (Emalgen 210P), polyoxyethylene stearyl ether (Emalgen 306P), polyoxyethylene oleyl ether, polyoxyethylene higher alcohol ethers and polyoxyethylene nonylphenyl ether (Emalgen 903). As the nonionic surfactants, there may also be used polyoxyethylene derivatives such as polyoxyethylene derivatives (Emalgen A-60), sorbitan monolaurate (Reodol SP•L10), sorbitan monolaurate (Reodol Super SP•L10) and sorbitan distearate (Emazole S•20); oxyethylene oxypropylene block copolymers; and sorbitan fatty acid esters.

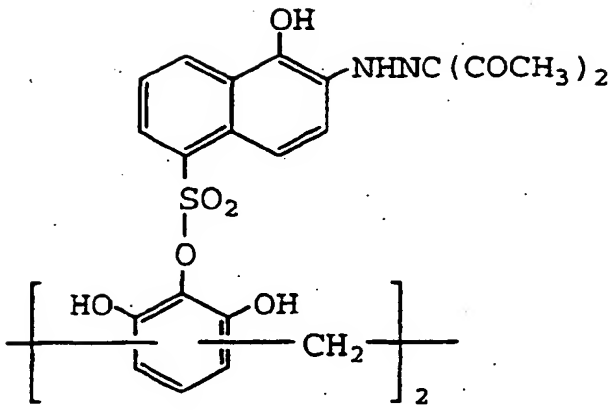
[0208] Examples of the further nonionic surfactants may include polyoxyethylene sorbitan fatty acid esters such as polyoxyethylene sorbitan monolaurate (Reodol TW-L120), polyoxyethylene sorbitol tetraoleate (Reodol 430) and glycerol monostearate; polyoxyethylene sorbitol fatty acid esters; and glycerin fatty acid esters. Further, as the still other nonionic surfactants, there may also be used polyoxyethylene fatty acid esters such as polyethylene glycol monolaurate (Emanone 1112), polyoxyethylene alkylamine (Amito 105) and alkyl alkanol amide (Aminone PK•02S); polyoxyethylene alkyl amines; and alkyl alkanol amines.

[0209] Examples of the anionic surfactants and the amphoteric surfactants may include alkyl amines, quaternary ammonium salts, alkyl betaines and amine oxides such as stearyl amine acetate (Acetamine 86), lauryltrimethyl ammonium chloride (Coatamine 24P), cetyltrimethyl ammonium chloride (Coatamine 60W), distearyldimethyl ammonium chloride (Coatamine D86R), alkylbenzyldimethyl ammonium chloride (Samizole C), lauryl betaine (Anhitol 24B), lauryldimethyl amine oxide (Anhitol 20N) and laurylcarboxymethylhydroxyethyl imidazolium betaine (Anhitol 20Y). Meanwhile, the names in parentheses after the respective surfactants indicate tradenames of commercially available products all produced by Kao Co., Ltd.

[0210] Also, as the water-soluble organic solvent added to the release agent solution, there may be used water-soluble organic solvents such as isopropyl alcohol, benzyl alcohol, ethyl cellosolve, butyl cellosolve, phenyl cellosolve, propyl glycol and diacetone alcohol. The total amount of the surfactant and water-soluble organic solvent added to the release agent is usually 0.01 to 50% by weight, preferably 0.1 to 20% by weight, more preferably 0.1 to 10% by weight.

[0211] The release step may be usually conducted by conventionally known methods such as dipping the photosensitive lithographic plate in the above release agent solution or coating the release agent solution onto the photosensitive lithographic plate. Such procedures may be usually conducted at a temperature of preferably about 10 to 50°C, more preferably about 15 to 45°C for a period of about 5 seconds to 10 minutes.

[0212] In an alternate release method, a penetrant such as the above alkali developing solution, the above surfactant and water-soluble organic solvent added to the alkali developing solution and a solution containing these materials is



(II)

<On-printing machine plate making, printing and regeneration steps>

[0217] The respective steps were conducted using an apparatus of the same type as shown in Fig. 1 which was arranged in a printing chamber. The casing (1) was slid and opened to accommodate a whole part of the plate making apparatus therein. The printing chamber was ventilated as follows. That is, an exhaust duct (12) was fitted to an exhaust port provided near floor so as to discharge air supplied from an air intake port provided near a ceiling portion of the casing and introduced through a dust filter (11) and an opened front wall of the casing (1) into an inside thereof, from the exhaust port to the exhaust duct (12). Then, the respective plate making, printing and regeneration steps were conducted by the following methods.

[0218] First, a plate cylinder (21), a bracket cylinder (22) and an impression cylinder (23) were kept apart from each other, and delivery of papers to the impression cylinder (23) was stopped. Thereafter, the photosensitive plate material composed of the positive-type photosensitive composition was supplied from a plate material-feeding mechanism (4) and coated onto the substrate (3) fixed on the plate cylinder (21), and then dried by hot air at 100°C for 2 minutes, thereby preparing a positive-type photosensitive lithographic plate having thereon a positive-type photosensitive composition layer in a coating amount of 2.4 g/m^2 (step A).

[0219] Next, by using an exposure mechanism (5) having a semiconductor laser light source with an emission wavelength of 830 nm (manufactured by Applied Techno Co., Ltd.; 40 mW) capable of scanning exposure with a laser beam spot having a spot diameter of 20 μm at a scanning speed of 40 m/min, the thus obtained photosensitive lithographic plate was subjected to various exposure energies for 200 lines of 1 to 99% halftone dot images (step B). Thereafter, a plate-treating agent composed of an alkali developing solution (8 times-diluted solution of "DP-4" produced by Fuji Photo Film Co., Ltd.) was supplied from a plate-treating agent-feeding mechanism (80) onto the image-exposed photosensitive lithographic plate. and contacted therewith at 28°C for 30 seconds, and then the photosensitive lithographic plate was washed with water to form images thereon (step C). The alkali developing solution and the wash water were supplied by temporarily keeping an inking roller of an inking device (6) and a dampening roller of a dampening device (7) away from the plate cylinder and temporarily using a plate material-dissolving solution-feeding mechanism (81) of the below-mentioned plate material-removing mechanism and a wash water-feeding mechanism (83). Namely, the below-mentioned plate material-dissolving solution-feeding mechanism (81) was temporarily used as an alkali-developing solution-feeding mechanism. As a result of such procedures, there was obtained a printing plate on which 1 to 99% halftone dot images were reproduced. It was confirmed that the sensitivity of the printing plate was 150 mJcm^{-2} when calculated as exposure energy for reproducing 3% halftone dot images.

[0220] After completion of the plate making steps (A) to (C), the printing ink and the dampening water were supplied onto the surface of the images formed on the photosensitive lithographic plate from the inking device (6) and the dampening device (7), respectively. Successively, while rotating the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) while keeping in contact with each other and delivering printing papers between the bracket cylinder (22) and the impression cylinder (23), 10,000 copies of prints were produced (step D). As the printing ink and the dampening water, there were used a process ink "HIGH ECHO MAGENTA" produced by Toyo Ink Co., Ltd., and "ASTRON NO. 1 MARK II" produced by Nikken Kagaku Co., Ltd., respectively.

[0221] After completion of the printing step (step D), the respective cylinders were kept apart from each other and the delivery of papers to the impression cylinder (23) was stopped again. Then, the image portions formed on the substrate (3) were removed by the plate material-removing mechanism according to the following procedure to regen-

to the development treatment was detachably fixed onto a plate cylinder of a lithographic printing machine having the substantially same structure as that shown in Fig. 1 ("DIA F-2" manufactured by Mitsubishi Heavy Industries, Co., Ltd.). Then, a dampening water ("ASTRON NO. 1 MARK II" produced by Nikken Kagaku Co., Ltd.) and a printing ink ("HIGH ECHO MAGENTA" produced by Toyo Ink Co., Ltd.) were supplied onto the surface of the positive-type lithographic plate from a dampening water feeding mechanism and an ink feeding mechanism, respectively, whereby 10,000 copies of prints were produced (step D).

[0230] After completion of the printing, the printing ink remaining on the lithographic plate was washed off while keeping the lithographic plate fixed on the plate cylinder of the lithographic printing machine. Then, propylene glycol monomethyl ether as an image removing agent was applied onto the surface of the lithographic plate by a roller of an image removing mechanism to dissolve the positive images, and the surface of the lithographic plate was wiped off with gauze to remove the positive images, and then washed with water to regenerate the aluminum substrate (step E). Thereafter, the coating solution composed of the same positive-type photosensitive composition as used above was coated again on the thus regenerated aluminum substrate by a roller of a photosensitive composition solution coating mechanism, and then heat-dried to form a photosensitive layer thereon, thereby producing a positive-type photosensitive lithographic plate (step A). Successively, using the exposure mechanism, the photosensitive layer was subjected to scanning exposure with a laser source (step B), and the same developing solution as used above was supplied onto the photosensitive layer from the plate-treating agent-feeding mechanism (80) by a roller of a developing mechanism to subject the photosensitive layer to development treatment, thereby producing a positive-type lithographic plate having positive images thereon (step C).

[0231] As a result, it was confirmed that the sensitivity of the positive-type lithographic plate was the same as that before regeneration, i.e., 150 mJ/cm^2 when calculated as exposure energy for reproducing 3% halftone dot images. Further, the positive-type lithographic plate thus subjected to exposure energy of 150 mJ/cm^2 and then the development treatment was used to produce 10,000 copies of prints by the same method as above, thereby obtaining high-quality prints.

[0232] Meanwhile, when the thus obtained positive-type photosensitive lithographic plate produced using the regenerated aluminum substrate was allowed to stand for 10 hours under the condition of irradiating with light having a light intensity of 400 lux from a while fluorescent lamp (36W white fluorescent lamp "NEOLUMISUPER FLR40S-W/M/36" manufactured by Mitsubishi Denki Co., Ltd.), and then subjected to the same development treatment as above, it was confirmed that substantially no lack of coating film was caused, and the photosensitive lithographic plate showed a good safe light property under the white fluorescent lamp.

Example 3:

<Preparation of positive-type photosensitive lithographic plate>

[0233] The coating solution as prepared in Example 2 was coated onto the surface of the same aluminum substrate as produced in Example 2 by the using a wire bar. While rotating the plate cylinder at a peripheral speed of 2 m/min, air at 25°C was blown to the rotating aluminum substrate from a blower "MF930-BC" (manufactured by Oriental Motor Co., Ltd.) disposed at the position spaced by 25 cm apart therefrom for 5 minutes to form a photosensitive layer thereon. In this case, the photosensitive plate material layer coated on the aluminum substrate was heat-dried for 2 minutes by a light-heating-type drying mechanism including two halogen lamps (manufactured by Ushio Denki Co., Ltd.; output: 1,000W; emission efficiency: 85%; emitted light peak: 1,200 nm; irradiation area: 250 mm x 60 mm) disposed at the position spaced by 3 cm from the surface of the plate cylinder. The halogen lamps were arranged such that the major axis (250 mm) of the rectangular irradiation plane was parallel with an axis of the plate cylinder, and the minor axis (60 mm) thereof extended in the circumferential direction of the plate cylinder. As a result of such a heat-drying procedure, there was obtained a positive-type photosensitive lithographic plate having a photosensitive layer with a dry thickness of 2.4 μm thereon. The irradiated light intensity density upon the heat-drying was 5.7 W/cm^2 when calculated from the specification of the lamp.

<Plate making and printing steps>

[0234] Successively, the above positive-type photosensitive lithographic plate was subjected to image exposure and then development treatment by the same method as in Example 2. In the development treatment, the exposed positive-type photosensitive lithographic plate was fixed on an aluminum cylinder having a diameter of 10 cm at room temperature of 25°C such that the photosensitive layer formed thereon faced outward. Also, an image detector (high-speed high-performance color image sensor manufactured by Kiehen Co., Ltd.; a sensor constituted by a CCD camera "CV-070" and a monitor built-in controller "CV-750") was disposed at the position spaced by 20 cm apart from the photosensitive layer. The image detector was set such that signals were generated when the value obtained by dividing a

<Plate making, printing and regeneration steps>

[0239] Next, by using an exposure apparatus having a semiconductor laser light source with an emission wavelength of 830 nm (manufactured by Applied Techno Co., Ltd.; maximum output: 30 mW), the thus obtained positive-type photosensitive lithographic plate was subjected to scanning exposure for thin line images by irradiation of beam spot focussed to a diameter of 20 μm with various exposure energies (step B). Then, the photosensitive lithographic plate was immersed in the below-mentioned alkali developing solution (7) supplied from the plate-treating agent-feeding mechanism (80) at 28°C for 30 seconds, and then washed with water to produce a positive-type lithographic plate on which thin line images were reproduced (step C). It was confirmed that the sensitivity of the positive-type lithographic plate was 150 mJ/cm^2 when calculated from minimum exposure energy for reproducing the thin line images.

[0240] Then, a dampening water ("ASTRON NO. 1 MARK II" produced by Nikken Kagaku Co., Ltd.) and a printing ink ("HIGH ECHO MAGENTA" produced by Toyo Ink Co., Ltd.) were supplied onto the surface of the positive-type lithographic plate from a dampening water feeding mechanism and an ink feeding mechanism, respectively, whereby 10,000 copies of prints were produced (step D).

[0241] After completion of the printing, the printing ink remaining on the lithographic plate was washed off while keeping the lithographic plate fixed on the plate cylinder of the lithographic printing machine. Then, propylene glycol monomethyl ether as an image removing agent was applied onto the surface of the lithographic plate by a roller of an image removing mechanism to dissolve the positive images, and the surface of the lithographic plate was wiped off with gauze to remove the positive images, and then washed with water to regenerate the aluminum substrate (step E). Thereafter, the coating solution composed of the same positive-type photosensitive composition as used above was coated again on the thus regenerated aluminum substrate by a roller of a photosensitive composition solution coating mechanism, and then heat-dried to form a photosensitive layer thereon, thereby producing a positive-type photosensitive lithographic plate (step A). Successively, using the exposure mechanism, the photosensitive layer was subjected to scanning exposure for thin line images different from those of the previous exposure by a laser source (step B), and the following alkali developing solutions (1) to (7) were respectively supplied on the photosensitive layer by a roller of a development mechanism (plate-treating agent-feeding mechanism) to subject the photosensitive layer to development treatment, thereby producing a positive-type lithographic plate having positive images thereon (step C).

[0242] Next, the thus obtained positive-type lithographic plate was used to conduct printing by the same method as above. When the 1,000th print was visually observed to examine the adhesion of ink onto non-image portions thereof, it was confirmed that no ink adhesion was caused on the non-image portions of the lithographic plate in the case where the alkali developing solutions (1) to (7) were used.

[0243] Successively, the lithographic plate was regenerated using the respective alkali developing solutions (1) to (7) by the same method as above except that different thin line images were formed thereon at each time, the number of copies of prints produced was reduced to just 1,000 for each printing, and the printing procedure was repeated 8 times. As a result, it was conformed that when the alkali developing solutions (1) and (2) were used, no ink adhesion onto the non-image portions was recognized even upon the 8th regeneration procedure, and when the alkali developing solutions (3) to (7) were used, only slight ink adhesion onto the non-image portions was observed at the 8th regeneration procedure.

[0244] The above treatments were conducted using the following alkali developing solutions (1) to (7) each having a pH value of not less than 11.

(1) Aqueous solution containing 1.0% by weight of sodium silicate (SiO_2/Na_2O = 3/1; and so forth on), 1.0% by weight of sodium hydroxide and 0.01% by weight of betaine-type amphoteric surfactant ("Anhitol 24B" produced by Kao Co.. Ltd.) ($[SiO_2]/[M]$ = 0.37)

(2) Aqueous solution containing 1.0% by weight of sodium silicate, 1.0% by weight of sodium hydroxide and 0.01% by weight of betaine-type amphoteric surfactant ("Anhitol 86B" produced by Kao Co., Ltd.) ($[SiO_2]/[M]$ = 0.37)

(3) Aqueous solution containing 1.0% by weight of sodium silicate, 1.0% by weight of sodium hydroxide and 0.01% by weight of polyoxyalkylene-type nonionic surfactant ("Emalgen A-60" produced by Kao Co., Ltd.) ([SiO2]/[M] = 0.37)

(4) Aqueous solution containing 1.0% by weight of sodium silicate, 1.0% by weight of sodium hydroxide and 0.01% by weight of polyoxyalkylene-type nonionic surfactant ("Emalgen PP-150" produced by Kao Co., Ltd.) ($[SiO_2]/[M]$ = 0.37)

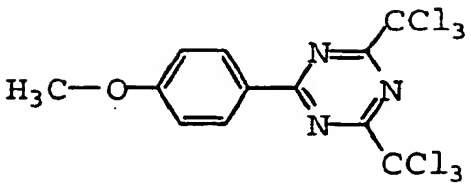
(5) Aqueous solution containing 1.0% by weight of sodium silicate, 1.0% by weight of sodium hydroxide and 0.01% by weight of sodium sulfonate-type anionic surfactant ("Perex NBL" produced by Kao Co., Ltd.) ($[SiO_2]/[M]$ = 0.37)

(6) Aqueous solution containing 1.0% by weight of sodium silicate, 1.0% by weight of sodium hydroxide and 0.01% by weight of sodium sulfonate-type anionic surfactant ("Perex SS-H" produced by Kao Co., Ltd.) ($[SiO_2]/[M]$ = 0.37)

(7) Aqueous solution containing 1.0% by weight of sodium silicate, 1.0% by weight of sodium hydroxide and 0.01% by weight of quaternary ammonium salt-type cationic surfactant ("Coatamine 24P" produced by Kao Co., Ltd.)

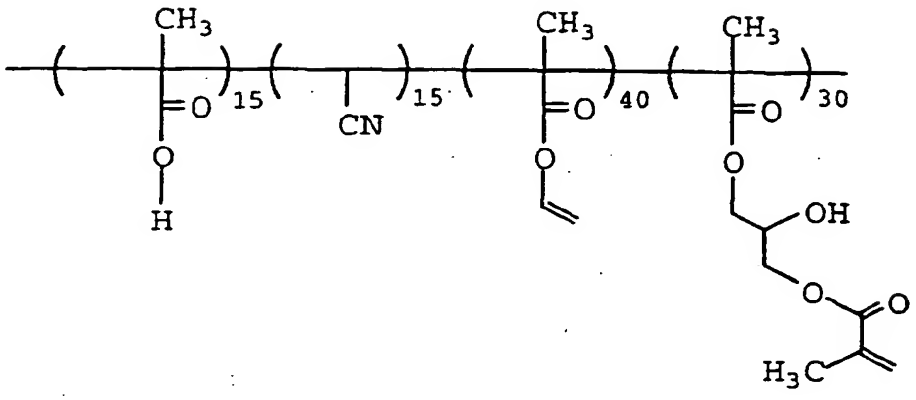
[Radical generator]

[0248]



[High-molecular binder]

[0249]

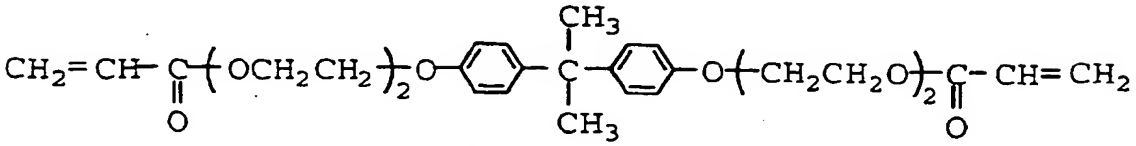


[0250] Numerals indicate molar ratios.
[0251] Weight-average molecular weight: 200.000

[Ethylenically unsaturated monomer]

[0252]

Compound 1



ed onto the substrate (3) fixed on the plate cylinder (21), and then dried by blowing thereto hot air at 100°C for 2 minutes, thereby preparing a photosensitive lithographic plate having thereon a photosensitive layer with a thickness of 1 μm (step A).

[0257] Next, by using a semiconductor laser (5) with an emission wavelength of 830 nm as an exposure mechanism (manufactured by Applied Techno Co., Ltd.; 30 mW), the photosensitive lithographic plate was exposed to light of spiral line images. More specifically, while rotating the plate cylinder (21) and moving the semiconductor laser (5) parallel with the axial direction of the plate cylinder (21) while keeping the distance between the plate cylinder (21) and the semiconductor layer (5) constant, laser light focused to beam spot having a spot diameter of 20 μm was irradiated onto the photosensitive lithographic plate at a scanning speed of 40 m/min (step B). Thereafter, a plate-treating agent composed of a 0.5 wt. % sodium carbonate aqueous solution was supplied from a plate-treating agent-feeding mechanism (80) onto the image-exposed photosensitive lithographic plate to swell and dissolve non-exposed portions of the photosensitive layer. The non-exposed portions were washed off with water to form images on the photosensitive lithographic plate (step C). The sodium carbonate aqueous solution and the wash water were supplied by temporarily keeping an inking roller of an inking device (6) and a dampening roller of a dampening device (7) away from the plate cylinder and temporarily using a plate material-dissolving solution-feeding mechanism (81) of the below-mentioned plate material-removing mechanism and a wash water-feeding mechanism (83). Namely, the below-mentioned plate material-dissolving solution-feeding mechanism (81) was temporarily used as an sodium carbonate aqueous solution feeding mechanism.

[0258] After completion of the plate making step (steps A to C), the printing ink and the dampening water (10°C) were supplied onto the surface of images formed on the photosensitive lithographic plate from the inking device (6) and the dampening device (7), respectively. Successively, while rotating the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) at 470 revolutions per hour while being kept in contact with each other and delivering printing papers between the bracket cylinder (22) and the impression cylinder (23), 3,000 copies of prints were produced (step D). As the printing ink and the dampening water, there were used "HIGH ECHO KURENAI" produced by Toyo Ink Co., Ltd., and "ASTRON NO. 1 MARK II" produced by Nikken Kagaku Co., Ltd. (concentration: 1% by weight; pH: 5), respectively.

[0259] After completion of the printing step (step D), the respective cylinders were kept apart from each other and the delivery of papers to the impression cylinder (23) was stopped again. Then, the image portions formed on the substrate (3) were removed by a pate material removing mechanism according to the following procedure to regenerate the substrate (step E).

[0260] First, after disposing an anti-staining tray (86) between the bracket cylinder (22) and the impression cylinder (23), while rotating the plate cylinder (21), a plate material-dissolving solution composed of a negative lithographic plate-developing solution (aqueous solution containing 10% by weight of 2-phenoxyethanol and 3% by weight of diethanolamine) was supplied from the plate material-dissolving solution-feeding mechanism (81) onto the surface of the images formed on the photosensitive lithographic plate fixed on the plate cylinder (21). Then, physical stimulus was applied to the images by a plate material-stripping roller (82) to remove the images from the substrate (3).

[0261] Then, the wash water was supplied from the wash water-feeding mechanism (83) onto the surface of the thus regenerated substrate (3). As a result of this procedure, the plate material-dissolving solution remaining on the surface of the substrate (3) was removed. Further, after residual liquid still remaining on the surface of the substrate (3) was removed by a waste solution suction mechanism (84), the surface of the substrate (3) was dried by an air-drying mechanism (85).

[0262] After completion of the regeneration step (step E), the process was returned to the above plate making and printing steps (steps A to D), and these steps were repeatedly conducted. As a result, it was confirmed that prints having the same clear spiral line images as those obtained using the printing plate before regeneration were produced.

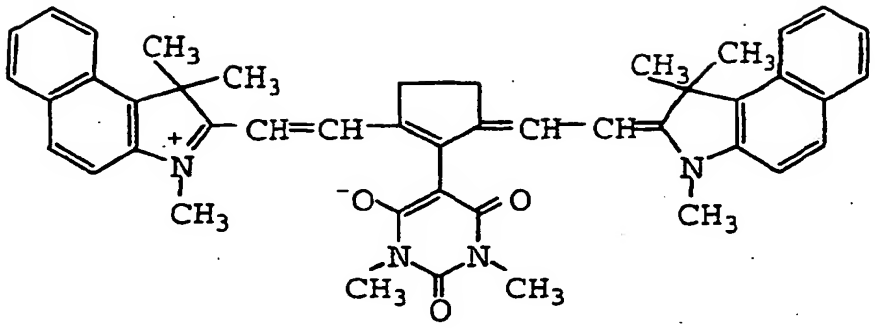
Example 6:

<Production of substrate>

[0263] An aluminum plate having a thickness of 0.2 mm was degreased with a 3 wt. % sodium hydroxide aqueous solution, and then subjected to electrolytic etching treatment in a 18 g/liter hydrochloric acid bath at a temperature of 25°C and a current density of 80 A/dm^2 for 15 seconds. Successively, the thus treated aluminum plate was subjected to death mat treatment in a 1 wt. % sodium hydroxide aqueous solution at 50°C for 5 seconds, neutralized with a 10 wt. % hydrochloric acid aqueous solution at 25°C for 5 seconds, washed with water, and then anodized in a 30 wt. % sulfuric acid bath at a temperature of 30°C and a current density of 10 A/dm^2 for 16 seconds. Further, the aluminum plate was washed with water and then dried to produce an aluminum substrate having an anodic oxide film in an amount of 21 mg/dm^2.

[0264] The thus obtained aluminum substrate was subjected to peel test to measure a peel strength of a gummed

(B-1)



(C) Photopolymerization initiator:

[0269] 2-(p-methoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine (C-1): 5 parts by weight

(D) High-molecular binder:

[0270] Reaction product obtained by reacting a copolymer of methacrylate (80 mol%) and methacrylic acid (20 mol%) with 3,4-epoxycyclohexylmethylacrylate (60 mol% of carboxyl groups of the methacrylic acid components was reacted; acid number: 60; weight-average molecular weight: 75,000) (D-1): 45 parts by weight

Other component:

[0271] Pigment (ethyl violet): 5 parts by weight

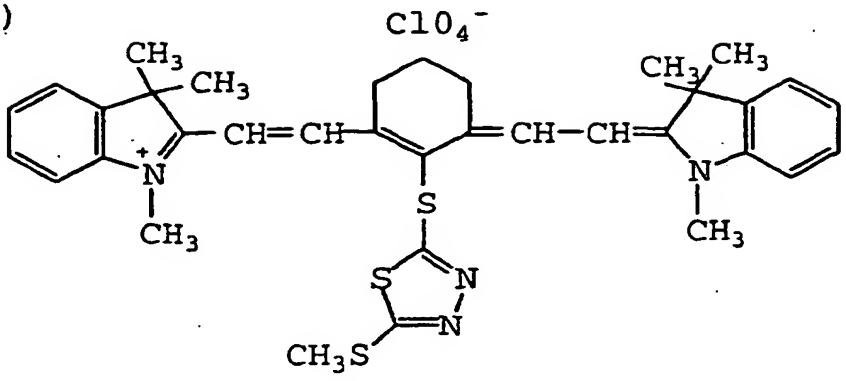
<Plate making. printing and regeneration steps>

[0272] Next, by using an exposure apparatus having a semiconductor laser light source with an emission wavelength of 830 nm ("Trend Setter 3244T" manufactured by Creo Co., Ltd.), the thus obtained negative-type photosensitive lithographic plate was subjected to scanning exposure with various exposure energies. Then, the photosensitive lithographic plate was immersed in a developing solution composed of 0.8% by weight of sodium carbonate and 3% by weight of an anionic surfactant ("Perex NBL" produced by Kao Co., Ltd.) at 25°C for 30 seconds, and then washed with water to produce a negative-type lithographic plate on which scanning line images were reproduced. It was confirmed that the sensitivity of the obtained printing plate was 100 mJ/cm^2 when calculated from minimum exposure energy for reproducing the scanning line images.

[0273] Successively, the negative-type lithographic plate thus exposed to minimum exposure energy of 100 mJ/cm^2 and then to the development treatment was detachably fixed onto a plate cylinder of a lithographic printing machine having the same structure as shown in Fig. 1 ("DIA F-2" manufactured by Mitsubishi Heavy Industries, Co., Ltd.). Then, a dampening water ("ASTRON NO. 1 MARK II" produced by Nikken Kagaku Co., Ltd.) and a printing ink ("HIGH ECHO MAGENTA" produced by Toyo Ink Co., Ltd.) were supplied onto the surface of the negative-type lithographic plate from a dampening water feeding mechanism and an ink feeding mechanism, respectively, whereby 10,000 copies of prints were produced.

[0274] After completion of the printing, the printing ink remaining on the lithographic plate was washed off while keeping the lithographic plate fixed on the plate cylinder of the lithographic printing machine. Then, an image removing agent composed of a negative-type lithographic plate-developing solution (aqueous solution containing 10% by weight of 2-phenoxyethanol and 3% by weight of diethanolamine) and 10% by weight of aluminum hydroxide particles dispersed therein was applied onto the surface of the lithographic plate by a roller of an image removing mechanism, and the surface of images formed on the lithographic plate was brushed and then wiped off with gauze to remove the images therefrom. Further, the lithographic plate was washed with water to regenerate the aluminum substrate (step E). Thereafter, the coating solution composed of the same photopolymerizable composition as used above was coated again on the thus regenerated aluminum substrate by a roller of a photopolymerizable composition solution coating mechanism, and then heat-dried to form a photosensitive layer thereon, thereby producing a negative-type photosensitive lithographic plate (step A). Successively, using the exposure mechanism, the photosensitive layer was subjected

(B-2)



(C) Photopolymerization initiator:

[0282] Organoboric acid salt of n-butyl-tris(m-fluorophenyl) boron anion and tetramethyl ammonium cation (C-2): 5 parts by weight

(D) High-molecular binder:

[0283] Polymethylmethacrylate (weight-average molecular weight: 30,000) (D-2): 40 parts by weight

Other component:

[0284] Pigment (ethyl violet): 5 parts by weight

[0285] It was confirmed that the gummed tape peel strength from the surface of the aluminum substrate was 300 g/cm, and the sensitivity of the negative-type photosensitive lithographic plate was 150 mJ/cm^2. Also, it was confirmed that the degree of residual line images on the aluminum substrate regenerated after printing was the rank A, and the sensitivity of the negative-type lithographic plate produced using the regenerated aluminum substrate was the same as that before the regeneration, i.e., 150 mJ/cm^2. Then, the negative-type lithographic plate exposed to the exposure energy of 150 mJ/cm^2 and subjected to the printing development was used to produce 10,000 copies of prints. As a result, it was confirmed that the obtained prints had a high quality. In addition, it was confirmed that the negative-type photosensitive lithographic plate produced using the regenerated aluminum substrate also exhibited a good safe light property under a white fluorescent lamp.

Example 8:

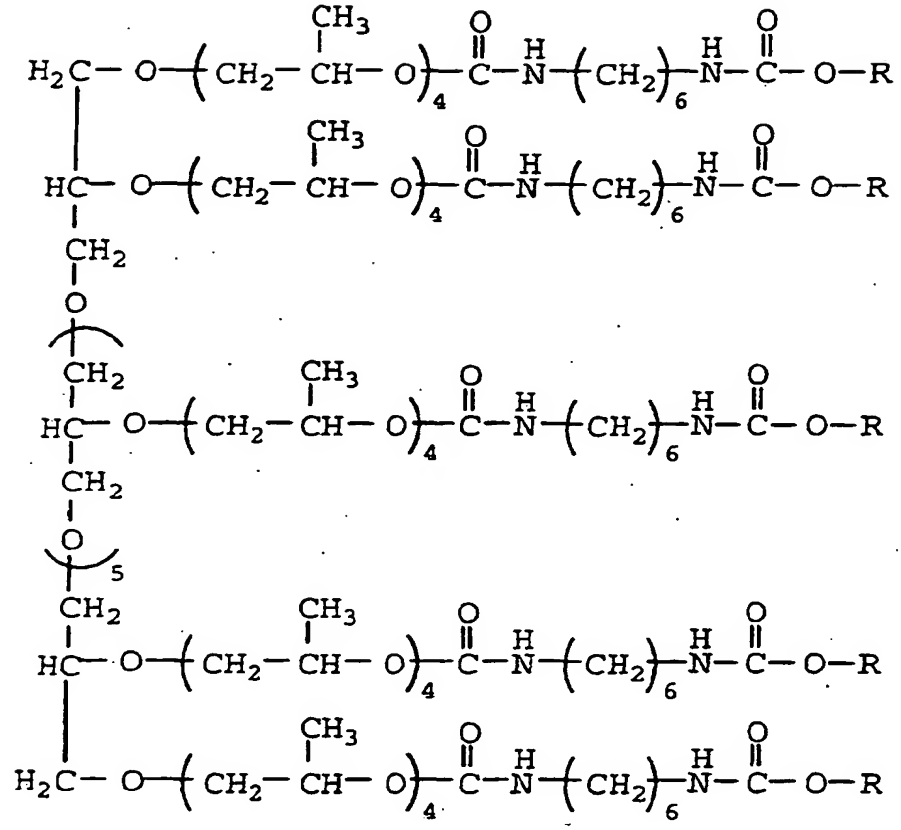
[0286] An aluminum substrate was produced by the same method as defined in Example 6 except that after anodization, the aluminum plate was immersed in a 50 ppm carboxymethyl cellulose aqueous solution for 5 seconds and then dried to form a hydrophilic polymer thin layer having a thickness of 0.01 μm on the surface thereof. Further, using the thus produced aluminum substrate, the same procedure as defined in Example 6 was conducted except that a coating solution prepared by mixing the following components (A) to (D) as well as the following other component in 1,090 parts by weight of cyclohexanone while stirring at room temperature was applied onto the aluminum substrate without forming an oxygen-shielding layer thereon.

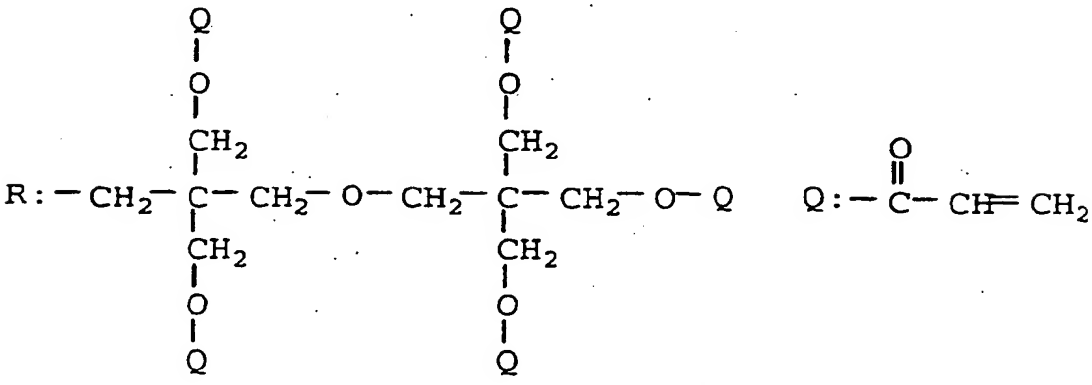
(A) Ethylenically unsaturated compound:

[0287]

Compound (A-6) shown below: 11 parts by weight
Compound (A-7) shown below: 24 parts by weight (A-6)
1:1 mixture of:

(A-7)





(B) Sensitizer:

[0288] Compound (B-1) shown above: 2 parts by weight

(C) Photopolymerization initiator:

[0289] Compound (C-1) shown above: 5 parts by weight

Example 11:

[0299] The same procedure as defined in Example 6 was conducted except that the aluminum substrate was anodized using phosphoric acid instead of hydrochloric acid, and was formed thereon with an oxide film in an amount of 18 mg/dm^2. It was confirmed that the gummed tape peel strength from the surface of the aluminum substrate was 1,000 g/cm, the sensitivity of the negative-type photosensitive lithographic plate was 100 mJ/cm^2, and the degree of residual line images on the aluminum substrate regenerated after printing was the rank C.

Example 12:

<Production of substrate>

[0300] The same procedure as defined in Example 6 was conducted to produce a negative-type photosensitive lithographic plate except that the coating solution was prepared by mixing the following components (A) to (D) as well as the following other component in a mixture of 400 parts by weight of propylene glycol monomethyl ether acetate and 740 parts by weight of cyclohexanone while stirring at room temperature.

(A) Ethylenically unsaturated compound:

[0301]

Compound (A-1) shown above: 22 parts by weight
Compound (A-6) shown above: 11 parts by weight
Compound (A-7) shown above: 22 parts by weight

(B) Sensitizer:

[0302] 4,4'-bis(diethylamino)benzophenone (B-3): 9 parts by weight

(C) Photopolymerization initiator:

[0303] 2.2'-bis(o-chlorophenyl)-4,4',5,5'-tetraphenylbiimidazole (C-3): 15 parts by weight

(D) High-molecular binder:

[0304] Reaction product obtained by reacting a copolymer of methyl methacrylate (80 mol%) and methacrylic acid (20 mol%) with 3,4-epoxycyclohexylmethylacrylate (50 mol% of carboxyl groups of the methacrylic acid components was reacted: acid number: 53; weight-average molecular weight: 70,000) (D-6): 45 parts by weight

(E) Hydrogen-donating compound:

[0305] 2-mercaptobenzothiazole (E-1): 5 parts by weight
[0306] N-phenylglycine benzylester (E-2): 5 parts by weight

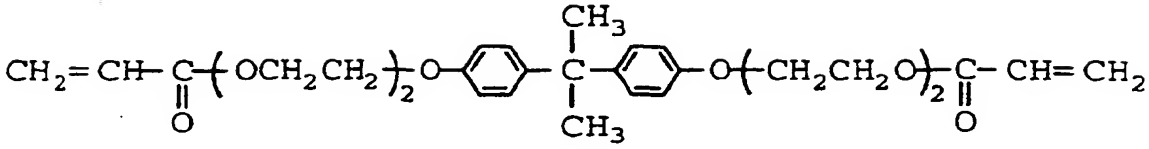
(F) Amine compound:

[0307] Tribenzylamine (F-1): 3 parts by weight

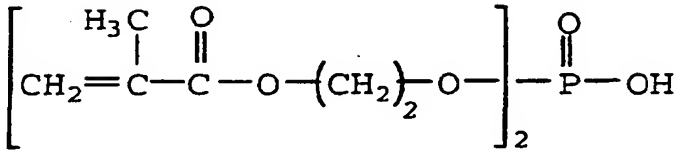
Other component:

[0308] Pigment (copper phthalocyanine): 4 parts by weight
[0309] Dispersant ("Disper BYK 161" produced by BYK Chemie Co., Ltd.): 2 parts by weight
[0310] Surfactant ("Emalgen 104P" manufactured by Kao Co., Ltd.): 2 parts by weight
[0311] Surfactant ("S-381" manufactured by Asahi Glass Co., Ltd.): 0.3 part by weight
[0312] Next, by using a violet laser exposure apparatus with an emission wavelength of 410 nm ("Cobalt 8" manufactured by Escher-Grad Co., Ltd.), the thus obtained negative-type photosensitive lithographic plate was subjected to scanning exposure with various exposure energies. Then, the photosensitive lithographic plate was immersed in a developing solution composed of an aqueous solution containing 0.7% by weight of sodium carbonate and 0.5% by

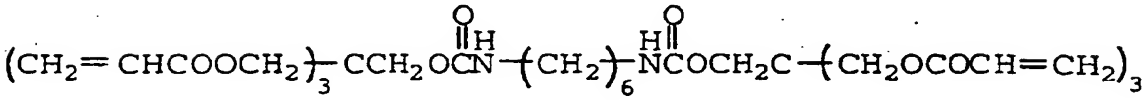
(1)



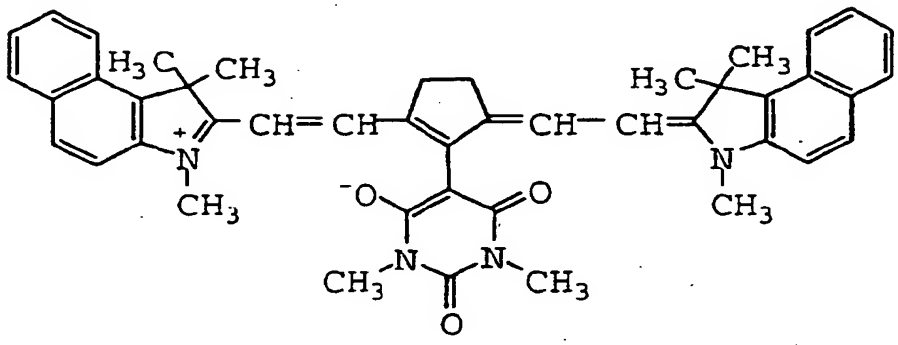
(2)



(3)



(4)



(N-4) Photopolymerization initiator:

[0319] 2-(p-methoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine (C-1): 5 parts by weight

Other component:

[0320] Pigment (ethyl violet): 5 parts by weight

[0321] The thus obtained negative-type photosensitive lithographic plate was subjected to scanning line image exposure with various exposure energies by the same method as in Example 4 (step B). Then, the negative-type photosensitive lithographic plate was immersed in a developing solution composed of an aqueous solution containing 0.8%

2. A process according to claim 1, wherein the steps (A) to (E) are conducted on a plate cylinder of a printing machine.

3. A process according to claim 1 or claim 2, wherein in the photosensitive layer-coating step (A), the photosensitive plate material supplied and coated onto the substrate is heat-dried by irradiating near-infrared light having a light intensity density of not more than 100 Wcm^{-2} thereto for a period of not less than 0.1 second.

4. A process according to any one of claims 1 to 3, wherein in the exposure step (B), the light exposure is conducted using a laser beam at a scanning speed of not less than 0.1 m/min.

5. A process according to any one of claims 1 to 4, wherein the plate-treating agent-feeding mechanism used in the development step (C) is provided as a separate mechanism independent of the dampening device used in the printing step (D).

6. A process according to any one of claims 1 to 5, wherein an alkali development solution is used as the plate-treating agent used in the development step (C).

7. A process according to claim 6, wherein the alkali development solution contains a surfactant.

8. A process according to any one of claims 1 to 7, wherein in the development step (C), conditions of the images formed on the photosensitive layer of the photosensitive lithographic plate are detected to control the developing conditions on the basis of the detected data.

9. A process according to claim 8, wherein the data detected in the development step (C) include a reflection absorbance of each of image portions and non-image portions as measured at a detection wavelength of 400 to 1,300 nm.

10. A process according to claim 8 or claim 9, wherein the data detected in the development step and used for controlling the developing conditions are those satisfying such a condition that a value obtained by dividing a reflection absorbance A by a reflection absorbance B is not less than 0.5,

wherein A represents a reflection absorbance obtained by subtracting a reflection absorbance of the substrate from the reflection absorbance of the image portions; and B represents a reflection absorbance obtained by subtracting the reflection absorbance of the substrate from the reflection absorbance of the non-image portions.

11. A process according to any one of claims 8 to 10, wherein the developing conditions to be controlled is at least one condition selected from the group consisting of a temperature of a developing solution, a developing time, a feed amount of the developing solution, a frequency of feed of the developing solution, and a contact (rubbing) pressure, a contact density and a contact frequency of an image-forming material.

12. A process according to any one of claims 1 to 11, wherein a release agent is used in the substrate regeneration step (E).

13. A process according to claim 12, wherein the release agent is an aqueous alkali solution.

14. A process according to claim 12 or claim 13, wherein the release agent contains a water-soluble organic solvent.

15. A process according to any one of claims 12 to 14, wherein the release agent contains a surfactant.

16. A process according to any one of claims 1 to 15, wherein the photosensitive plate material is a positive-type photosensitive composition containing:

(P-1) a light-heat converting material capable of converting light absorbed from a light source for image exposure into heat; and
(P-2) an alkali-soluble resin.

17. A process according to claim 16, wherein the light-heat converting material (P-1) is a light-absorbing dye having an absorption band for a part or whole of a wavelength region of 600 to 1,300 nm.

18. A process according to claim 16 or claim 17, wherein the light-absorbing dye as the light-heat converting material

(B) exposing the thus prepared photosensitive lithographic printing plate to image light by an exposure mechanism;
(C) supplying a plate-treating agent onto the thus image-exposed photosensitive lithographic plate from a plate-treating-agent-feeding mechanism, followed by, if required, applying physical stimulus thereto, to form images thereon;
(D) supplying a printing ink and dampening water onto surfaces of the images formed on the photosensitive lithographic plate, from an inking device and a dampening device, respectively, to conduct printing by rotating the plate cylinder, the bracket cylinder and the impression cylinder in contact with each other and delivering a printing paper between the bracket cylinder and the impression cylinder, followed by keeping the respective cylinders apart from each other and stopping delivery of papers to the impression cylinder again; and
(E) removing image portions formed on the substrate by a plate material-removing mechanism, thereby regenerating the substrate.

28. A regenerative on-printing machine plate making and printing apparatus mainly comprising:

a lithographic printing machine comprising a plate cylinder (21), a bracket cylinder (22), an impression cylinder (23), an inking device (6) and a dampening device (7);
a substrate-fixing means (31) for fixing a substrate (3) on the plate cylinder (21);
a plate material-feeding mechanism (4) for supplying a photosensitive plate material onto the substrate (3);
an exposure mechanism (5) for exposing a photosensitive lithographic plate formed by supplying and coating the photosensitive plate material onto the substrate, to image light;
a plate material-removing mechanism comprising a plate-treating-agent-feeding device (80), a plate material-dissolving solution-feeding mechanism (81), and a plate material-stripping roller (82) which may be optionally provided, a wash water-feeding mechanism (83), an waste solution suction mechanism (84) and an air-drying mechanism (85);
a casing (1) having a slidable and openable front for accommodating all of said components therein; and
a dust filter (11) disposed on a ceiling portion of the casing (1),
the plate cylinder (21), the bracket cylinder (22) and the impression cylinder (23) being adjustably disposed to be spaced apart from each other, delivery of papers to the impression cylinder (23) being controllably stopped, and the inking device (6) and the dampening device (7) being adjustably disposed to be spaced apart from the plate cylinder (21).

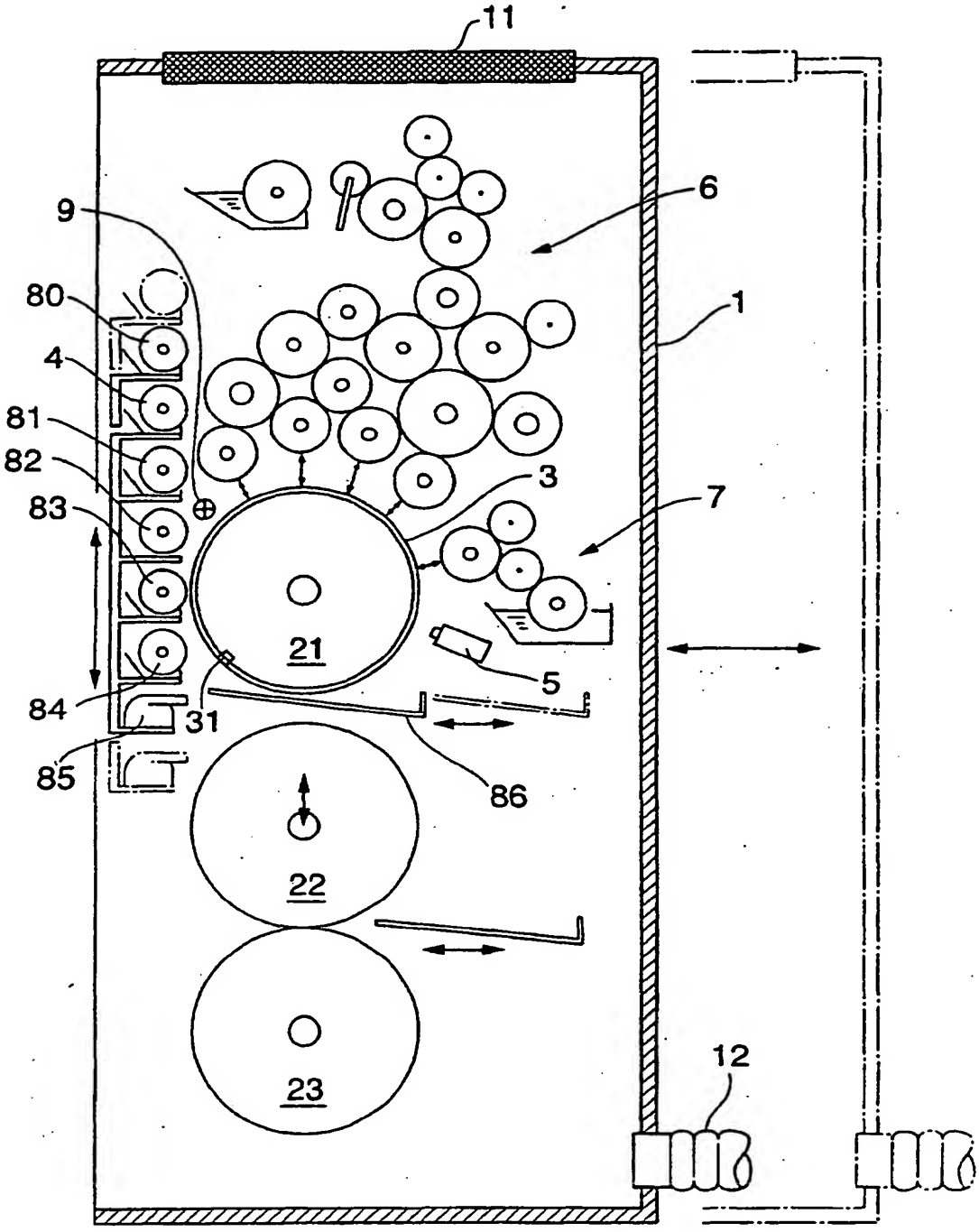
29. A process for producing a positive-type lithographic plate, comprising:

forming a photosensitive layer composed of a positive-type photosensitive composition containing (P-1) a light-heat converting material capable of converting light absorbed from a light source for image exposure into heat and (P-2) an alkali-soluble resin, on a surface of an aluminum substrate to obtain a positive-type photosensitive lithographic plate having a photosensitive layer thereon;
subjecting the photosensitive layer of the thus obtained positive-type photosensitive lithographic plate to scanning exposure using a laser source and then development treatment to form positive images thereon;
detachably fixing the positive-type lithographic plate on a plate cylinder of a printing machine to print a printing material with ink;
removing the positive images formed on the surface of the aluminum substrate while keeping the positive-type lithographic plate fixed on the plate cylinder, to regenerate the aluminum substrate; and
forming a photosensitive layer composed of the positive-type photosensitive composition containing the components (P-1) and (P-2) again on the surface of the regenerated aluminum substrate, followed by subjecting the photosensitive layer to scanning exposure using the laser source and then development treatment again to form the positive images thereon.

30. A process for producing a negative-type lithographic plate, comprising:

forming a photosensitive layer composed of a photopolymerizable composition containing (N-1) a high-molecular binder, (N-2) an ethylenically unsaturated compound, (N-3) a sensitizer and (N-4) a photopolymerization initiator, on a surface of an aluminum substrate to form a negative-type photosensitive lithographic plate;
subjecting the photosensitive layer of the thus formed negative-type photosensitive lithographic plate to scanning exposure using a laser source capable of emitting light having a wavelength region of 400 to 1,300 nm and then development treatment to form a negative-type lithographic plate having negative images thereon;
detachably fixing the negative-type lithographic plate on a plate cylinder of a printing machine to print a printing

FIG.1



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/04144

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B41F7/02, B41C1/10, G03F7/00, G03F7/004

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] B41F7/02, B41C1/10, G03F7/00, G03F7/004

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2002
Kokai Jitsuyo Shinan Koho 1971-2002 Toroku Jitsuyo Shinan Koho 1994-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-216835 A (Mitsubishi Chemical Corp., Mitsubishi Heavy Industries, Ltd.), 10 August, 1999 (10.08.99), Full text; Fig. 1 (Family: none)	1-30
Y	EP 802457 A1 (AGFA-GEVAERT naamloze vennootschap), 22 October, 1997 (22.10.97), Full text; Figs. 1 to 2 & JP 10-58851 A	1-30
Y	US 5713287 A (Creo Products Inc.), 03 February, 1998 (03.02.98), Full text; Figs. 1 to 2e & JP 9-99535 A & DE 19612927 A	1-30

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 July, 2002 (18.07.02)	30 July, 2002 (30.07.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)